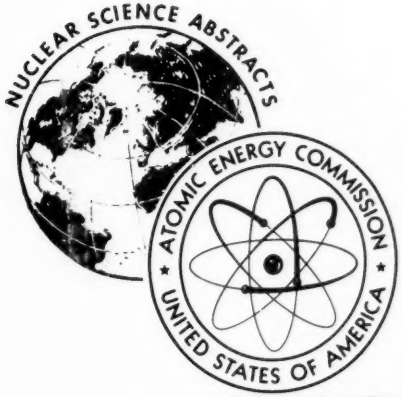

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Volume 20 Number 5

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March 15, 1966

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Volume 20, Number 5, March 15, 1966

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NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

6694 (MIT-952-2) RADIUM AND MESOTHORIUM POISONING AND DOSIMETRY AND INSTRUMENTATION TECHNIQUES IN APPLIED RADIOACTIVITY. Annual Progress Report. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics). May 1965. Contract AT (30-1)-952. 213p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Results of studies concerning Ra and mesothorium toxicity in humans are reported. Investigations concerning differential uptake of injected Ra and Th in humans are described. Research results on radiobiology, nuclear physics, instrumentation techniques, and radiochemistry are summarized. (J.R.D.)

6695 (NP-15607) RAPPORT ANNUEL, 1964. (Annual Report, 1964). (Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)). 225p. Dep. mn.

The organization and personnel of the Interuniversity Institute of Nuclear Sciences is given. The nuclear science courses given by Belgium universities are outlined. Abstracts of papers published by the Interuniversity Institute in the fields of nuclear physics, nuclear chemistry, radiobiology, and therapeutics are compiled. (J.S.R.)

6696 (ORNL-3853, pp 66-77) CYTOCHEMISTRY AND CELL REPRODUCTION. (Oak Ridge National Lab., Tenn.).

Progress is reported in studies on the cytochemistry and cell reproduction of the yeast Saccharomyces cerevisiae and the protozoa Tetrahymena pyriformis. Data are included from studies on the spontaneous reversion of auxotropic mutants of Saccharomyces during vegetative growth; the separation of acid-soluble nucleotides and related compounds from yeast cells during different growth conditions; the incorporation of ^{3}H-thymidine into cytoplasmic DNA during the cell cycle of Tetrahymena; and biochemical, physiological, and structural changes during the cell cycle of Tetrahymena. Studies on the morphology of brown fat tissue in mice revealed an age-dependent transformation of multilocular to unilocular cell types. This transformation was correlated with an age-dependent decrease in tolerance and adaptability to a cold environment. (C.H.)

6697 (ORNL-3853, pp 78-87) CELL GROWTH AND DIFFERENTIATION. (Oak Ridge National Lab., Tenn.).

Progress is reported in studies of cell growth and differentiation in amphibians and mammals. Data are included from studies of the morphogenetic effects of different RNA fractions of rat liver and their hydrolysates on the ectoderm of newts, Triturus pyrrhogaster or Triturus vulgaris; the demonstration of a membranous component in Triturus oocyte nucleoli; the development of a chromatographic method for the resolution, purification, and analysis of egg yolk proteins and results of the gradient elution of yolk proteins from eggs of the killifish Fundulus heteroclitus; an immunochemical comparison of α-crystalline of the lens between mice and newts; and the synthesis of DNA, RNA, and tissue specific proteins during lens regeneration in newts. (C.H.)

6698 (ORNL-3853, pp 141-2) SUBCELLULAR AND VIRAL PHYSIOLOGY. (Oak Ridge National Lab., Tenn.).

Preliminary results show that mouse α-crystalline lens protein can be isolated by zonal ultracentrifugation. Further studies of purity and additional physical-chemical studies are in progress. (C.H.)

6699 (ORNL-3853, pp 151-4) NUCLEIC ACID CHEMISTRY. (Oak Ridge National Lab., Tenn.).

A complete analysis of the major nucleosides was accomplished by elution ion exchange chromatography in less than 1 hr using as little as 10 nanomoles of material. Gel filtration proved to be a rapid, quantitative, and nondegradative procedure for the isolation of oligonucleotides. Results are reported from investigations of the preparation and properties of deoxynucleotide polymerizing enzymes and deoxynucleotidyl transferase from calf thymus gland and DNA polymerase from Micrococcus lysodeikticus. (C.H.)

6700 (ORNL-3853, pp 183-207) CARCINOGENESIS PROGRAMS. (Oak Ridge National Lab., Tenn.).

Progress is reported in studies on fundamental aspects of carcinogenesis. Results are included from a study of the metabolic difference in epithelium of the normal cervix and human squamous cell carcinoma; immune reaction to the Shope papilloma virus of rabbits in humans; enzyme reactions in rat tumors in culture; protein synthesis in livers of rainbow trout; ribosome synthesis in rat liver; the effects of uv on DNA synthesis in mammalian cells in culture; electron microscopic studies of germinal center changes in reticular cells of mice under different conditions of stress and after antigenic stimulation; the effects of various carcinogenic chemicals on a number of widely separated biological systems; the aerosol inoculation of influenza virus into mice; and the physiology of virus-host interactions. (C.H.)

6701 (ORNL-3853, pp 207-11) ULTRACENTRIFUGE DEVELOPMENT PROGRAM. (Oak Ridge National Lab., Tenn.).

Zonal centrifugation techniques were used for studies of native glycogen isolated from Tetrahymena; lipid peroxidation in rat tissue homogenates; and the fractionation of adenovirus antigens. Continuous-flow centrifugation was used for the isolation of myxovirus from large volumes of tissue culture fluid. (C.H.)

6702 (ORNL-TM-1288) REGRESS—A MULTIPLE REGRESSION AND CORRELATION PROGRAM WITH GRAPHIC OUTPUT FOR MODEL EVALUATION. Van Dyne, George M. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 54p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

This general multiple regression and correlation program was written with the intent of being simple and yet flexible. The program will handle up to 60 variables and will give summary statistics on the input variables as well as correlation and regression analyses. Deviations from the model are calculated and a variety of Calcomp plots are available. Options within the program allow reading data from cards or tape, variable format or standard format, names generated or names read in, weighted regression or nonweighted regression, a variety of transgenerations, regression through the origin or not through the origin, plots of each variable against deviations from the model and/or plots of each independent variable against each other independent variable and/or plots of each independent variable against the dependent variable, or plots of the dependent variable with each independent variable with the dependent variable corrected for differences of all other independent variables from their means. The program is written in FORTRAN 63 and is available as a main program, REGRESS1, or as a subroutine REGRESS2. (auth)

6703 (SGAE-SS-1/1965) UNTERSUCHUNGEN ZUM STUFENMECHANISMUS DER THERMOREGULATION. (Study of Step Mechanism of Thermoregulation). Locker, A. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). [1965]. 15p. Dep. mn.

The body temperature and the oxygen consumption of male white mice were affected by the drugs valium and taractan (in doses from 5 to 25 mg/kg) in the environmental temperature range from 12.5 to 35°. That environmental temperature at which proportional temperature control is possible is a function of the dose and toxicity of the drugs. In plotting the individual values of the O_2 consumption (in absolute values or in percentage of the corresponding normal values) against the body temperature, curves result in which two constant ranges or stages of the O_2 region can be detected; these constant regions depend equally on the dose applied and the toxicity of the drug, but were clearest in plotting the individual values of the per cent oxygen consumption obtained with taractan. It was assumed that the central nervous thermal receptors lying in the hypothalmus and in the spinal cord had differing excitation thresholds and resolve the stage reactions of the O_2 consumption through their different predispositions. (tr-auth)

6704 INFLUENCE OF INTRAPERITONEALLY INJECTED IRRADIATED LIVER TISSUE ON LIVER REGENERATION OF HEPATECTOMISED RATS. Voutilainen, A.; Taehti, E. (Univ., Helsinki). Ann. Med. Exptl. Biol. Fenniae (Helsinki), 43: No. 1, 29-31(1965).

The character of the mitoses was primarily normal. The mitotic counts had risen 2 days after hepatectomy and one day after the tissue injection in all the groups except that in which the liver tissue was given a dose of 5,000 rad. The increase in the mitotic counts was highly significant ($P < 0.001$) compared with the mitotic counts of this group. Two weeks after hepatectomy and 13 days after tissue injection the mitotic counts were at normal level. The weight indices 2 weeks after hepatectomy showed an almost significant increase ($P < 0.5$) in the tissue suspension group and a significant increase ($P < 0.01$) in the group given 10,000 rad compared with the hepatectomized and 5,000 rad groups. The mitotic counts in the transplanted group were at the same level as that of the control group. However, the fact that the weight index showed an almost significant rise in the tissue suspension group compared with the control group argues in favor of tissue stimulation. It shows that there was mitotic stimulation as well, but so labile and of such short duration that it could not be elicited. Effect of inhibitory growth factors on liver regeneration was produced by injecting homogenates of liver tissue irradiated in vitro. This effect was highly significant with a dose of 5,000 rad. In addition to the mitotic counts, the weight indices displayed this inhibition ($P < 0.5$). A dose of 10,000 rad tended to have a more stimulating effect, for the weight index rose significantly in 2 weeks compared with both the control group and the preceding group ($P < 0.01$). The present study confirmed the finding that autolytic tissue may stimulate the regeneration, but also contains factors capable of blocking the mitotic cycle of normal cells undergoing regeneration. It is possible to release the inhibitor by means of a fixed dose of irradiation, in this case a dose of 5,000 rad. The stimulative and inhibitory growth factors in tissue are obviously labile and easy to release. (TCO)

6705 APPLICATIONS OF THE ELECTRON SPIN RESONANCE METHOD IN RADIOBIOLOGY. Redhardt, Albrecht (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik, 2: 303-19(1965). (In German).

The first results obtained on amino acids, proteins, and simple impact biological systems show that the electron resonance method in its application to radiobiological problems permits assumptions that connect the causal chain between primary quantum absorption and biological end effect directly on the first term of this change. This means first a significant improvement of the knowledge of the mechanism of biological radiation damage. On the other hand the early representation of the method seen in the causal effect presents difficulties in the correlation between biological end effect and ESR observation. These difficulties can be partially circumvented by shortening of the chain, i.e., by selection of simple biological systems as investigation object. However it then appears necessary to investigate the very different stabilization conditions necessary for different radical types and the energy and charge out-put processes both for the biological end effect and for the radical picture obtained with the electron resonance method. These investigations are in process. (tr-auth)

6706 TESTING OF THE INTERACTION BETWEEN MICROORGANISMS OF A POPULATION BY STATISTICAL METHODS. Noack, D. (Institut fuer Mikrologie und Experimentelle Therapie der Deutschen Akademie der Wissenschaften zu Berlin, Jena, Ger.). Biophysik, 2: 361-7(1965). (In German).

In the evaluation of radiobiological experiments with microorganisms, in many cases the number of colonies on or in solid nutrients was determined. The interactions to be expected in the bacteria on colonies lead to a falsification of the research results; however accurate knowledge of these interactions is essential for the experiment. A statistical method was given that represents an analysis of the scattering of the numerical results. The analysis is based on formalism of the discrete Markoff process. With this analysis it can be determined whether an interaction is present, to what extent research results are falsified, and the type of interaction. (tr-auth)

6707 PERMEABILITY OF THE ALVEOLAR MEMBRANE SOLUTES. Taylor, Aubrey E.; Guyton, Arthur C.; Bishop, Vernon S. (Univ. Medical Center, Jackson, Miss.). Circ. Res., 16: 353-62(Apr. 1965).

Movement of D_2O, ^{24}Na, ^{42}K, and other materials between fluid in the alveoli and fluid circulating through the pulmonary vessels was studied in an isolated, perfused dog's lung. The permeability coefficients of the pulmonary membrane for ^{42}K, urea, ^{24}Na, glucose, D_2O, and dinitrophenol (DNP) were 56.5 ± 3.5, 22.9 ± 9.2, 7.5 ± 2.1, 3.1 ± 0.7, 400, and 400×10^{-7} cm/sec, respectively. The effect of varying the flow rate on the permeability coefficient of ^{24}Na was investigated, and the data failed to show any significant correlation between the flow limits of 3.8 to 12.8 cm/min g lung tissue. The D_2O and DNP disappearance curves from the vascular compartment were so steep that it was impossible to take samples rapidly enough to make accurate measurements. Calculations showed that the rate of transport of the solutes across the alveolar membrane approached the flow-rates of the solutes in the vascular perfusion fluid. However, from the steepness of the slopes it was possible to calculate that the min permeability coefficient for D_2O and DNP was at least 400×10^{-7} cm/sec. Thus, the permea-

bility of the membrane was about three times as great for urea as for ^{24}Na, seven to eight times as great for ^{42}K, and at least 400 times as great for D_2O and DNP. The results show that the alveolar has permeability characteristics similar to those of the usual cell membrane. The interstitial fluid volume of the lung (extravascular sodium space) was measured and yielded a value in normal lungs of 0.250 ± 0.129 ml/g lung tissue. In edematous lungs, this space averaged three times the normal value. (BBB)

6708 UNSTABLE MUTATION IN NEUROSPORA. Grigg, G. W. (Commonwealth Scientific and Industrial Research Organization, Sydney). Heredity, 20: 138-41 (Feb. 1965).

Properties of an unstable histidine (his$^+$) mutant of Neurospora are described. Uninucleate microconidia from a his-3 strain G_{g59} were irradiated with uv to a survival of 10% and plated on selective media. Fifty-nine cultures from both uv and control groups, detected because of their ability to grow on either of the selective media used (minimal or complete), were subcultured and tested. Only 25 colonies proved completely stable when retested over 4 weeks. Fourteen of these retested over a longer period proved stable for two yr. The remaining 37 showed distinct and permanent alterations in their growth characteristics. As possible causes of the instability two explanations of the instability are: prototrophic heterokaryon change to nonprototrophic homokaryons, and the labile attachment of episomic factors in the prototrophs involved to either the h$^-$ or suppressor of h$^-$ genes. Likely, neither hypothesis is mutually exclusive. While the original unstable prototrophs may be the result of the intervention of an episome-like factor, the complete loss of the prototrophic character in all the cells of a single colony may be the consequence of differential survival of the nonprototrophic cells over the prototrophic ones. (TCO)

6709 COMBINED ACTION OF H_2O_2 AND NUCLEIC COMPOUNDS ON INFUSORIA. Popov, A. S. Radiobiologiya, 5: 652-5(1965). (In Russian).

A nucleoside (thymidine, cytidine, uridine, adenosine, or guanosine), or a pyrimidine or purine base (uracil, cytosine, or adenine) was allowed to stand in the cold for two hours in contact with an equimolar amount of H_2O_2. The solutions were run at concentrations of 5, 2.5, 1, and 0.5×10^{-4} M. Catalase was added to some of the experiments 20 min before the beginning of the experiments. Paramecium caudatum was added to the solution, and after 60 minutes the solution was sampled and tested for survival and average number of mitoses. The results were compared with those obtained with pure H_2O_2 solutions in each case. Uracil and adenine with added H_2O_2 had a depressing effect on the rate of mitoses, but had no effect on the survival of infusoria. Cytosine did not modify the effect of H_2O_2 at all. In contrast to the pyridimine and purine bases, the nucleosides had a moderating effect on the toxic properties of H_2O_2. The degree of protection was different for various nucleosides. Cytidine and uridine showed a greater protective effect than thymidine. If the survival with pure H_2O_2 was taken as 100%, it was found that the survival was increased by 147, 53, and 50%, respectively, at uridine concentrations of 5, 2.5, and 1×10^{-4} M, by 36 and 38% at cytidine concentrations of 5 and 2.5×10^{-4} M, and by 20% at a thymidine concentration of 2.5×10^{-4} M. (TTT)

6710 INVESTIGATIONS ON THE DEPOSITION OF MICROORGANISMS IN IONIZING FIELDS. Joubert, J.; Fontanges, R.; Guerne, J. M.; Colobert, L.; Eyraud, Ch. (Centre de Recherches du Service de Sante, Lyon. Institut National des Sciences Appliquees, Villeurbanne, France). Staub, 25: 295-9(Aug. 1965). (In German).

Theoretical and experimental investigations into the accumulation of microörganisms in an ionizing field showed that the paths are determined by electric charges acquired by microörganisms under the effect of ion bombardment and thermal ion diffusion. In the case of elliptical or cylindrical microörganisms thermal ion diffusion may, in general, be disregarded. The viability of numerous types of these organisms is changed in passing through an ionizing field. It appeared that ozone had no harmful effect. It was difficult to distinguish to what extent the harmful effect is due to ions, electrons, and photons. In contrast to this the resistance of some types of bacteria is remarkable. (auth)

Ecology

6711 (ORNL-3849, pp 43-100) RADIATION ECOLOGY. Auerbach, S. I. (Oak Ridge National Lab., Tenn.).

Results of investigations concerning radiation effects on insects, plants, and animals in reactor and waste areas are summarized. Investigation results are also summarized on processes and components of terrestrial ecosystems. Clinch River and related aquatic studies are reported along with theoretical studies of food chains and systems ecology. (J.R.D.)

6712 (ORNL-TM-1317) FOREST MANAGEMENT PLAN, AEC OAK RIDGE RESERVATION. Curlin, J. W. (Oak Ridge National Lab., Tenn.). Sept. 28, 1965. Contract W-7405-eng-26. 42p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

AEC's Oak Ridge Reservation in Anderson and Roane Counties, Tennessee, consists of 37,500 acres of land surrounding Oak Ridge Operations' production plants. Approximately 30,000 acres are forested and serve as an outdoor laboratory for ecological research. Twenty-one thousand acres of this land were placed under forest management in 1964. Present growing stock is estimated at 56 million board feet and is growing at the rate of 3 million board feet annually. Practical aims of the management program are to maximize the yield and quality of timber, and assure a sustained yield of high-quality stumpage which will attract permanent wood-using industries to the Oak Ridge area. The Reservation is expected to contribute 1.5 million board feet annually toward these objectives. While accomplishing these objectives, concomitant information will be gathered on forest productivity and management data which will directly aid the ecological research program. (auth)

6713 (STI/PUB/21/15) RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY (1961-1963). Bibliographical Series No. 15. (International Atomic Energy Agency, Vienna (Austria)). 1965. 576p. IAEA $3.00; S 63,-; 18/-stg; F.Fr. 12,-; DM 10.50.

Approximately 1600 references on radioisotopes and radiations in entomology are given to reports, journals, and books published from 1961 through 1963. Separate author, subject, and insecticide indexes are included. (P.C.H.)

6714 MOVEMENT OF FALLOUT RADIONUCLIDES THROUGH THE BIOSPHERE AND MAN. Comar, C. L. (Cornell Univ., Ithaca, N. Y.). Ann. Rev. Nucl. Sci., 15: 175-206(1965).

A review in given of results of controlled metabolic studies and surveys on the movement of fallout radionuclides from the time they reach the surface of the earth until they are retained in man. The movement in soils and plants, aquatic food chains, animal products, dietary considerations, metabolic behavior in man, and levels in man are considered for ^{90}Sr, ^{137}Cs, and ^{131}I. (L.B.S.)

6715 THE TRANSPORT OF ^{65}Zn IN AN AQUEOUS ENVIRONMENT [Thesis]. Rowe, Donald Richard. Austin, Tex., Univ. of Texas, 1965. 116p.

The transport of ^{65}Zn was evaluated under simulated river conditions. Measurements were made of the distribution of ^{65}Zn among the sediment, plants, solution, and suspended material in a research flume. For purposes of comparison, a prior study was conducted to examine the uptake and release of ^{65}Zn among the components of a small-scale, closed ecological system, and detailed laboratory tests were made on the uptake and release of ^{65}Zn by clay minerals and Lake

Austin sediment. In the flowing system the greatest fraction of ^{65}Zn was associated with the solution and suspended material. It is expected that under actual river conditions, the greatest fraction of ^{65}Zn would be continuously transported downstream. On the other hand, the sediment in the non-flowing ecological system retained the greatest fraction of the originally released ^{65}Zn. It is therefore expected that ^{65}Zn in a non-flowing system such as a lake would become mainly associated with the bottom sediment. However, for rooted and macroscopic plants grown in either the closed or flowing ecological systems, there appears to be no significant difference in the uptake of ^{65}Zn. It is considered that photosynthesis is the prime element in the uptake and release of ^{65}Zn in plants. (Dissertation Abstr.)

6716 THE TRANSPORT OF ^{58}Co IN AN AQUEOUS ENVIRONMENT [Thesis]. Yousef, Yousef Aziz. Austin, Tex., Univ. of Texas, 1965. 136p.

The ecological environment of a river system was simulated with the aid of a specially adapted research flume. The characteristic transport of radioactive cobalt was evaluated by measuring the depletion of ^{58}Co in a plume resulting from the instantaneous release of $CoCl_2$. The residual effects of the plume were monitored for 90 days. The ecological analysis involved detailed evaluations of the detention characteristics exhibited by the bottom sediments, suspended solids, and biomass. From the accumulated and release data, detention coefficients were obtained for estimating the relative longitudinal transport of cobalt in an aqueous environment. In either the flowing or non-flowing ecosystem the greatest fraction of the ^{58}Co at a particular position in the stream remained in solution, although significant quantities were detained by the rooted plants, sediments, and suspended material. Laboratory and bench studies accompanied the larger flume studies. Various studies involving ion exchange, general sorption, and release were conducted with selected clays, fractions of bottom sediments, and typical biomass. (Dissertation Abstr.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstracts 6714, 6924, and 7456.

6717 (BNL–9755) METABOLISM OF TRITIUM–^{35}S-LABELED HEPARIN. Di Ferrante, N.; Popenoe, E. A. (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT-30-2-GEN-16. 6p. (CONF-650823–2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From International Symposium on the Biochemistry and Physiology of Connective Tissue, Lyon.

Heparin was doubly labeled with tritium and ^{35}S. Results are reported from tracer studies of the metabolism of injected heparin in rabbits and rats. Measurements of urinary radioactivity indicated 15% of the dose injected was excreted during the first hour and an additional 5% during the following 24 hr. The appearance in the blood of an excess of ^{35}S-labeled material indicated that some cleavage of sulfamic acid groups had occurred. Results of perfusion studies in isolated rat liver and rabbit kidney indicated that the kidney may be one of the sites capable of removing the sulfamic acid groups of heparin. No evidence was found of elimination of heparin in bile. (C.H.)

6718 (LA–3298) COMPUTER REDUCTION OF METABOLIC DATA OBTAINED FROM SCINTILLATION COUNTERS. Dean, P. N. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Dec. 1964. Contract W-7405-eng-36. 23p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The RTW series of computer programs written to analyze metabolic data are described. The programs calculate elapsed time between radionuclide administration and time of measurement, correct all data for changes in counting efficiency relative to measurements made on standards at zero time and for physical decay, if desired, and express the observed counting information as effective or biological retention at time of measurement. The program is written in FORTRAN II for use under the monitor system. (auth)

6719 (ORNL–3849, pp 183–213) INTERNAL DOSIMETRY. Snyder, W. S. (Oak Ridge National Lab., Tenn.).

A program designed to provide estimates of doses resulting from human exposure to radioactive materials that may enter the body is described. An analysis is included of previously reported data concerning distribution of stable elements in normal human tissue with emphasis on tissue-element correlation and age dependence. An analysis of data on absorption of Pu compounds by rats is included. (J.R.D.)

6720 (ORNL–3853, pp 143–50) NUCLEIC ACID ENZYMOLOGY. (Oak Ridge National Lab., Tenn.).

Deoxycytidylic acid residues were identified as a possible source of DNA breakage in T_2 bacteriophage. Data are included from studies of the oligodeoxyribonucleotide transferase system in T_2-infected Escherichia coli cells. The fractionation of Neurospora aminoacyl-sRNA synthetases revealed the presence of two chromatographically separable aspartyl-sRNA synthetase activities and evidence is presented that indicates that the two activities reflect two distinct enzymes. The coding properties of anomalously charged sRNA's were compared with those of homologously charged aminoacyl-sRNA's. Transfer RNA's were separated by liquid-liquid partition methods and fractions were tested singly with 12 amino acids for amino acid acceptor activity. Results are reported from studies of nucleotide metabolism during embryogenesis of the brine shrimp, Artemia salina; studies of the properties of RNA polymerase from embryos of Rana pipiens in various stages of development; and a study of the metabolic activity of oligonucleotides in mature ovarian eggs from Rana pipiens, in which ^{32}P was used as a tracer. (C.H.)

6721 (ORNL–3853, pp 161–9) ENZYMOLOGY. (Oak Ridge National Lab., Tenn.).

Results are reported from studies of protein synthesis by liver of puromycin-treated rats; ribosome activity during polypeptide synthesis in a cell-free system derived from Escherichia coli; the interaction of polyuridylic acid and ribosomes of trout liver; polysomes in rat spleen during the immune response; electron microscopic studies of the configuration of isolated embedded rat liver polysomes; the isolation and purification of the phenylalanine-activating enzyme from E. coli; physical properties of adenosine-5′-phosphosulfate reductase; protein synthesis in Clostridium pasteurianum; the isolation and purification of specific transfer RNA from E. coli; the genetic control of a system of isozymes for alcohol dehydrogenase in Drosophila melanogaster; and tracer studies of the coding properties of RNA. (C.H.)

6722 (ORNL–3853, pp 170–4) BIOCHEMICAL REGULATION. (Oak Ridge National Lab., Tenn.).

Progress is reported in studies of enzyme reactions during the synthesis of RNA in fetal and adult rat liver; the synthesis of tyrosine α-ketoglutarate transaminase in rat liver; the stimulation of the synthesis of RNA in rats by hydrocortisone; and the fractionation of rapidly labeled RNA from rat livers on hydroxylapatite columns. (C.H.)

6723 (ORNL–3853, pp 175–6) MICROBIOLOGY. (Oak Ridge National Lab., Tenn.).

Progress is reported in studies of the metabolic role of naphthoquinone isolated from the cell membrane of Streptococcus faecalis. Fluorimetric methods were used to follow the oxidation of reduced diphosphopyridine nucleotide (DPNH) in the presence of H_2O_2. Examination of DPNH peroxidase preparations revealed the presence of a fluorescent substance that indicated that unrecognized cofactors may be present in a variety of flavoproteins. (C.H.)

6724 (ORNL–P–1830) A COMPUTER CODE FOR ESTIMATION OF BODY BURDEN OF ^{90}Sr BASED ON O.R. AND BONE REMODELING WHICH ARE AGE DEPENDENT. Fisher, Henry L. Jr. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 14p. (CONF-651008–5). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Annual Bio-Assay Meeting, Albuquerque, N. Mex.

A computer code for analysis of data on ^{90}Sr metabolism

as a function of age was developed. A model for estimating ^{90}Sr body burden and metabolism as a function of age of the individual is described. In the model the skeleton is considered as a single compartment with a simple constant turnover rate coefficient for each age of the individual, and any recycling or exchange of Sr between various parts of the body is neglected. The results using the model were compared with others by applying it to several simple cases. (P.C.H.)

6725 (ORNL-P-1836) A DOSE ESTIMATE BASED ON STABLE-ISOTOPE DATA. Snyder, W. S. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 9p. (CONF-651008-6). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Annual Bio-Assay Meeting, Albuquerque, N. Mex.

A method for estimating doses of radioisotopes to human tissues based on stable isotope data is described. However, the method demands a knowledge of the daily intakes and of the mean concentrations in the organs involved of a stable isotope of the radioisotope in question. Hypothetical cases using the method are described. (P.C.H.)

6726 (STI/DOC/10/48) PLANT NUTRIENT SUPPLY AND MOVEMENT. Report of a Panel Held in Vienna, 9–13 November 1964. Technical Reports Series No. 48. (International Atomic Energy Agency, Vienna (Austria)). Nov. 1965. 165p. IAEA $3.50.

Seventeen papers discuss various aspects of plant nutrient supply and movement in soil systems. Emphasis was placed on tracer studies and applications of neutron activation analysis and isotope dilution in studies of ionic migration in clays and soils and soil-plant relations. (C.H.)

6727 (TID-3515(Suppl.1)) PHYSIOLOGICAL STUDIES EMPLOYING RADIOISOTOPES. Ward, Helen L. (comp.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). May 1965. 284p. Dep. mn; CFSTI $6.00 cy, $1.50 mn.

References (2578) on the use of radioisotopes in physiological studies are given to scientific literature published during the period 1958–1963. Separate author, isotope, and report number indexes are included. (auth)

6728 (TID-22369) CALCULATION OF GLYCOLYTIC REACTION RATES FROM SPECIFIC ACTIVITY DATA. DATA FROM ANAEROBIC ESCHERICHIA COLI TREATED WITH AN ANALOG COMPUTER. Garatun-Tjeldstoe, Oddvard; Klungsoeyr, Leiv (Bergen Univ. (Norway). Dept. of Biochemistry). [nd]. 21p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

An attempt was made to use ^{32}P specific activity data and concentrations of phosphorus containing intermediates in glycolysis to calculate glycolytic reaction rates. The problem was approached with an analog computer, which operated according to equations defining metabolic steady state, and describing the flow of isotope. The computer supplied a large number of solutions of these equations, in the form of sets of reaction rates and the corresponding specific activity data, which were then compared to those experimentally found. A specially developed method for automatic parameter search was used to reduce the deviation between observed and computed specific activity data. Only preliminary values of reaction rates are available at present. Some of these are discussed with reference to other pertinent information. (auth)

6729 (TID-22375) MANNITOL KINASE AND MANNITOL-1-P DEHYDROGENASE IN ESCHERICHIA COLI. Klungsoeyr, Leiv (Bergen Univ. (Norway). Dept. of Biochemistry). [nd]. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Mannitol-1-P dehydrogenase (EC.1.1.1.17) was purified by a simple procedure from mannitol grown E. coli. The enzyme was separated from the main protein fraction by gel filtration on Sephadex G-75. It was further purified with ammonium sulfate fractionation, and treatment with the anion exchange gel Sephadex A-25. The active protein was homogeneous in the ultracentrifuge with an apparent molecular weight of 19300. Cell-free extracts of E. coli were found to contain a mannitol dehydrogenase, which probably is a D-mannitol : NAD oxidoreductase. The results indicate, but do not conclusively prove, that cell-free extracts of E. coli as prepared by the method described contain a mannitol kinase. (auth)

6730 (TID-22376) SOME STEPS IN THE METABOLISM OF HEXOSE-PHOSPHATES AND MANNITOL-PHOSPHATE IN ESCHERICHIA COLI. Klungsoeyr, Leiv (Bergen Univ. (Norway). Dept. of Biochemistry). [nd]. 40p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

In attempts to evaluate glycolytic reaction rates under varying conditions, several aspects of carbohydrate metabolism in Escherichia coli were investigated. This included: hydrolysis of hexosephosphates at pH values between 4.7 and 5.7; effect of a low pH upon isomerization of hexose-6-phosphates; and comparison of ethanol formation and mannitol + mannitol-1-phosphate formation as products by NADH reoxidation. The K_m of the E. coli acid phosphatase-system for Fru-1,6-P_2 increased from $2.30 \cdot 10^{-3}$ at pH 5.4 to $1.25 \cdot 10^{-2}$ at pH 4.7. The hydrolysis of Fru-1,6-P_2 must therefore be regulated by pH. At pH near 5 small variations in pH affect the rate of isomerization of Glc-6-P to Fru-6-P. In aerobically grown E. coli the anaerobic ethanol formation from glucose was about twice the mannitol + mannitol-1-P formation on a molar basis. In semi-anaerobic cells, the ethanol—but not the mannitol production was higher. (auth)

6731 MINERAL METABOLISM IN PRIMARY BONE TUMORS STUDIED BY EXTERNAL COUNTING OF ^{85}Sr. Wendeberg, Bo; Yamamuro, Takao (Univ. of Lund, Sweden). Acta Ortho. Scand., 36: 21-34(1965).

The uptake of intravenously injected ^{85}Sr in primary bone tumors was assayed by the external counting technique. Various types of tumors in 22 patients were studied. The patients were given less than 1 μC carrier-free ^{85}Sr per kg body weight. External counting was performed with a collimated scintillation detector, alternately using three sets of collimators. Activity measurements were made at various intervals after injection of ^{85}Sr, usually at about 1 and 2 weeks. Results were expressed as activity ratio, i.e., counting rate over bone tumor to counting rate over corresponding normal bone. The activity ratios were significantly higher than normal in osteogenic sarcomas. In solitary bone cysts and osteofibromas the activity ratios varied. Increased uptake of the isotope in a localized bone lesion is presumptive evidence of increased bone formation rate. Attempts were made to correlate the degree of roentgenologically evident periosteal reaction and sclerosis to the activity ratios, but no conclusive results were obtained. (TCO)

6732 NATURE AND AVAILABILITY OF IODINE IN FISH. Harrison, Michael T.; McFarlane, Sheena; Harden, Ronald McG.; Wayne, Edward (Western Infirmary, Glasgow). Amer. J. Clin. Nutr., 17: 73-7(Aug. 1965).

The absorption of ^{131}I by human volunteers eating fish contaminated with the radionuclide was examined. Other studies were carried out to determine the chemical nature of iodine in fish and to assess the extent of iodine losses during cooking. Adult female plaice (Pleuronectes platessa) were given 100 μC ^{131}I by injection into the coelomic cavity. The fish were killed two days later, the total radioactivity counted with a directional scintillation counter and the fillets removed. To examine the nature of iodine in fish, portions of fillet of plaice or haddock (Gadus aeglefinus), both uncooked and fried, were homogenized, the homogenate was centrifuged, and the precipitate separated from the supernatant and washed with deionized water. Results indicated that all the iodine present in the fillet, both radioactive and stable, was present in inorganic form. Effect of cooking on iodine content of fish was also studied, and losses of iodine resulting from cooking fillets of plaice and haddock are shown. Absorption of iodine from cooked fish was studied in ten patients with no evidence of gastrointestinal disorder. In all patients fecal excretion of ^{131}I was less than 1% of ingested radioactivity, and in four patients no ^{131}I was detectable. More than 80% of the ingested ^{131}I appeared in the

urine over the period of collection. When the fish were cooked, significant losses of iodine occurred. These losses were greatest after boiling, when an average of 58% of the iodine disappeared from the fish. When fish were grilled, the average loss of iodine was 23%; when fried, 20%. (TCO)

6733 ABSORPTIVE FUNCTIONS OF THE SYNOVIAL MEMBRANE. Cochrane, W.; Davies, D. V.; Palfrey, A. J. (St. Thomas's Hospital Medical School, London). Ann. Rheum. Dis., 24: 2-15(Jan. 1965).

Tissue responses to Thorotrast (ThO_2) injected into the knee joints of rabbits was studied by electron microscopy. The fine structure of the synovial membrane was examined one to 24 hrs after an injection of 0.5 ml of 50% Thorotrast in saline. One hour after injection Thorotrast was detected in the joint cavity, synovial cells, some cells of subsynovial tissue, and in interstices of both the intimal and subsynovial layers of the synovial membrane. The most prominent accumulations of Thorotrast granules occurred in vacuolated cells. No specific effects of ThO_2 were determined. (TCO)

6734 AN ELECTRON MICROSCOPICAL STUDY OF THE UPTAKE OF FOREIGN PARTICLES BY THE LIVER OF FOETAL AND ADULT RATS. Casley-Smith, J. R.; Reade, P. C. (Univ. of Adelaide). Brit. J. Exp. Pathol., 46: 473-80(Oct. 1965).

In adult and fetal rats the phagocytosis of Thorotrast (ThO_2), bacteria (Escherichia coli), and carbon particles (India ink) was studied by examining the fine structure of the liver at intervals after intravenous injection of these particles. In the livers of adult rats the ThO_2 and other test particles are found in endothelial cells and in hepatic parenchymal cells. In the fetal livers they are found in endothelial cells, parenchymal cells, and in primitive red cells. The smaller particles (carbon and Thorotrast) seemed to enter the cells in different ways. Like bacteria, aggregates of the smaller particles can be ingested in large (1-μ) indentations while separate small particles enter the cells in the normal small (about 50-mμ) vesicles. Others again enter by what is probably membrane flow. This is seen especially in the endothelial cells. There may be a fourth method of entry for smaller particles directly across the plasma membranes, since Thorotrast is found free in the cytoplasm. However, this may be an artefact, and more evidence is necessary before free particles of ThO_2 can be accepted as being present in the cytoplasm of a living cell. Many small vesicles rapidly coalesce to form large (1-μ) closely packed vesicles. These large vesicles, which would be visible in the light microscope, occur much more in the endothelial cells than in the parenchymal ones, where the particles are spread diffusely through the cell before accumulating in peribiliary bodies. The phagocytic vesicles frequently contain mixtures of the introduced particles of ThO_2 and carbon. While many endothelial cells contain some bacteria or ThO_2 particles, relatively few of them accumulate the material to a very marked extent. These few cells swell so as to nearly occlude the lumen, and often have processes extending for large distances between the parenchymal cells. They correspond to typical Kupffer cells. Within 1 min of injection the test particles are seen in the lumina of the sinusoids. Within 5 min some have entered the endothelial cells and after 15 min the ThO_2 and carbon particles are already aggregated in the large vesicles. After 25 min some of the bacteria in the endothelial cells often show signs of digestion, while 125 min from the time of injection many of the bacteria appear to be disrupted. (BBB)

6735 SEQUELAE OF THOROTRAST. Leitner, Z. A. Brit. Med. J., 2: 1062-3(Oct. 30, 1965).

A description is given of investigations on a large number of rabbits and rats which showed that Thorotrast was stored in the reticuloendothelial cells mainly of the liver, spleen, bone marrow, and brain-covering membranes; the organs, especially the liver, displayed fibrosis similar to atrophic cirrhosis; phagocytosis decreased 6 to 12 months after administration from the normal 38% to 4.2%; capillaries and small vessels were blocked by the Thorotrast particles in the reticuloendothelial cells, leading often to thrombosis. Although no changes could be found in the peripheral blood during the observation period of 18 to 24 months, the probability of radiation damage to the bone marrow and to other storage organs is great as the radiation dose from the usual 100 ml Thorotrast injection amounts to 1.24 μg of radium (near the toxic dose), persisting for an unlimited period. Warnings have been made against the use of Thorotrast in man because of the limited diagnostic value achieved at a very high risk. In 1934, experimental carcinogenesis with ThO_2 was reported and five cases of cerebral thrombosis after arteriography with ThO_2 were seen. However, Thorotrast was still used for diagnostic purposes in man after repeated warnings. A late report indicates that it has been in widespread use in Portugal until recently. It was concluded that Thorotrast should never be administered to patients with a life expectation of more than two years. (BBB)

6736 THE UPTAKE OF ^{85}Sr IN EXPERIMENTAL IMPLANTS OF FRESH AUTOGENOUS CANCELLOUS BONE; PROCESSED HETEROGENOUS CANCELLOUS BONE; PROCESSED HETEROGENOUS CANCELLOUS BONE PRETREATED WITH AN OSTEOGENETIC EXTRACT. Georgiade, N.; Matton van Leuven, M.; Dingwall, J. A.; Georgiade, R. (Duke Univ., Durham, N. C.). Bull. Soc. Int. Chir., 24: No. 1, 31-7(1965).

A comparison of the radioactive uptake of ^{85}Sr by rats that had received implants of fresh cancellous autogenous bone, processed cancellous bone, and heterogenous cancellous ground bone reconstituted with an osteogenetic extract showed that the uptake was greatest in the group which received implants of the processed heterogenous cancellous ground bone impregnated with a highly active mucopolysaccharide having all the chemical properties of chondroitin sulfate A and/or C. (Excerpta Med.)

6737 DISTRIBUTION OF RADIOCALCIUM IN THE TEETH AND BONES IN RATS. Liu, Ting-hsin (Peking Medical Coll.). Chin. Med. J., 84: 617-21(Sept. 1965).

Distribution of ^{45}Ca in the tissues of teeth and bones was examined by autoradiography in 25 rats, the duration of observation ranging between 5 min and 100 days. The rats ranged in age from 3 months to 2½ yr. (TCO)

6738 ACCUMULATION OF NATURAL RADIOACTIVE ELEMENTS BY AZOTOBACTER, ALGAE, AND PROTOZOA. Krasil'nikov, N. A.; Drobkov, A. A. Dokl. Akad. Nauk SSSR, 163: 486-7(July 11, 1965). (In Russian).

Azotobacter cells grown on Czapek's medium containing radium were placed on slides, fixed, and, in the dark, covered with a thin layer of A-2 nuclear photoemulsion, which is highly sensitive to alpha radiation. The cells were then left exposed for some time in darkness after which the slides with the biomass were developed, fixed, dried, and photographed under the microscope. The photographs clearly showed the tracks of the alpha particles released by the Azotobacter cells. All the cells did not form tracks, although they contained radium and its decay products. The fungus Phoma, various species of algae and protozoans were cultured in Knop's nutrient medium with radium. The subsequent procedure was the same as for Azotobacter. But these organisms failed to form tracks of alpha particles, which indicates that they more or less completely absorbed radium from the nutrient solution, accumulating it in their cells. The formation of tracks is indicative of the great kinetic energy of alpha particles and their activity in reducing the atoms of silver chloride and bromide to metallic silver. Presumably a similar function is performed by alpha particles inside living cells. Each particle ionizes neutral molecules and atoms, exciting them and imparting to them a higher energy potential. (ATD)

6739 ^{131}I RETENTION IN CALVES. Driever, C. W.; Christian, J. E.; Bousquet, W. F.; Plumlee, M. P.; Andrews, F. N. (Purdue Univ., West Lafayette, Ind.). J. Dairy Sci., 48: 1088-90(Aug. 1965).

Whole-body γ radioactivity measurements were made directly on large animals to illustrate the effect of carrier iodine on the rate of elimination of ^{131}I-iodide ion from Jersey and Holstein bull calves ranging in age from 8 to 27 days and in weight from 57 to 100 lb. The experiment was designed so that each animal served as its own control. The animals were dosed with 1 μC of carrier-free ^{131}I (as sodium iodide) and its retention was measured by whole-body counting until the retention was 3% or less for each animal. Initial total body activity due to ^{131}I was about 200,000 cpm as compared with ~2000 cpm for normal body potassium (^{40}K). The percentage retention was based on the total-body radioactivity measurement made 3 hr after administration of the ^{131}I to allow for absorption and distribution of the dose. This procedure was then repeated with carrier iodine (as KI, 750 mg/100 lb of body weight) for 12 days prior to receiving the ^{131}I. Each animal showed a marked reduction in the whole-body retention of ^{131}I when carrier was administered prior to and following administration of radioiodine. The percent retentions of ^{131}I after 500 hr before receiving carrier were about 5, 6, 7, and 6%, respectively. After receiving carrier they were about 0.5, 1.5, 3, and 1.5%, respectively. Apparently, the relatively large doses of carrier iodine completely saturated the body tissues with iodine, resulting in more rapid elimination of the ^{131}I administered. Whole-body retention of ^{131}I for the first 50 hr following dosing was not affected by the previous administration of carrier iodine. The fact that whole-body retention decreased more rapidly in the carrier-treated animals can thus be explained by a more rapid turnover of the ^{131}I. (BBB)

6740 CLINICAL APPLICATION OF RADIOACTIVE STEROIDS. Miyake, T. (Kyoto Univ.). Nippon Naibunpi Gakkai Zasshi, 40: 1054-64(1964). (In Japanese).

The isotope dilution method, isotope derivative method, double isotope dilution and derivative method were applied to cortisol, corticosterone and aldosterone. Determinations were made of the secretion rate, pool size, and clearance rate. The secretion rate and average plasma level of aldosterone were increased in primary aldosteronism, cirrhosis of the liver, malignant hypertension, diabetic nephropathy, and unilateral kidney disease. The secretion rate and average plasma level of cortisol were increased in Cushing's syndrome and decreased in Addison's disease, panhypopituitarism, and anorexia nervosa. The secretion rate and metabolic rate of cortisol were also decreased in cirrhosis of the liver, hepatitis, and hypothyroidism, while the metabolic rate was increased in hyperthyroidism. The daily secretion rates of dehydroepiandrosterone and dehydroepiandrosterone sulfate in normal females were 5.7 and 2.1 mg., respectively. The affinity for plasma protein was weaker with aldosterone and paramethasone than with cortisol and corticosterone. (Excerpta Med.)

6741 METABOLISM OF RADIONUCLIDES IN FISH. IV. STRONTIUM-CALCIUM DISCRIMINATION IN THE RENAL EXCRETION OF FISH. Oguri, Mikio; Takada, Naoko; Ichikawa, Ryushi (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Siusan Gakkaishi, 31: 435-8(June 1965).

Snake-head fish (Channa argus), 160 to 450 g body weight, received intraperitoneally 1 to 1.5 μC of ^{45}Ca and ^{89}Sr in 0.2 ml of distilled water, after closing the urogenital pore. Other fish were first injected with 10 mg of Diamox (acetazolamide). After about 24 hr, the urine stored in the urinary bladder was collected and the activity of ^{45}Ca and ^{89}Sr was measured separately using an aluminium absorber. The ratios in the urine were compared with those in the injected solution. Thus, the strontium-calcium discrimination ratio for renal excretion, defined as Sr/Ca in the urine : Sr/Ca in the injected solution, was calculated. The discrimination ratio was found to be 1.9 ± 2 on an average. Accordingly, more strontium is excreted than calcium in the renal excretion of fish. Diamox had no effect on the strontium-calcium discrimination in the urinary excretion of fish. The discrimination against strontium in favor of calcium was also ascertained in the uptake and accumulation of these minerals in the fish body from the diet or environmental water. The observed ratio, defined as Sr/Ca in the fish body : Sr/Ca in the environmental water, was 0.4 in case of the rainbow trout Salmo gairdnerii irideus. In fish, divalent mineral ions such as calcium and magnesium are excreted mainly via kidney, whereas the monovalent mineral ions such as sodium and potassium are excreted mainly through gill. Accordingly, strontium-calcium discrimination in the renal excretion is important in the contribution to the overall discrimination in the fish. (BBB)

6742 CLEARANCE RATE OF ^{131}I IN MECHANICALLY INJURED AND NORMAL MUSCLE TISSUE. Mulligan, Joan E.; Cassee, Gail E. (Univ. of California, San Francisco). Nursing Res., 14: 126-31(Spring 1965).

The possibility that the rate of resorption of intramuscularly injected ^{131}I might be altered when subsequent injections are made at the same site in muscle, which would undergo a certain degree of trauma, was tested. Mechanical injury was produced in rabbits by daily injections of 0.5 ml of physiological saline in the same area in the gluteus maximus muscle for 24 days. Four injections of 0.5 of saline containing 10 μC ^{131}I were given simultaneously in the same manner into both the injured side and the noninjured side on days 1, 15, 36, and 50 of the experiment. A double-probe, collimated scintillation detector unit with two rate meters and a two-channel recorder was used to follow the rates of clearance of ^{131}I from both sides simultaneously. When the cpm values from the two sides were compared, no significant difference was found. The hypothesis was rejected that the clearance rate of ^{131}I from the mechanically injured side was less than that from the control side. While the delay in absorption was not substantiated by this experiment, mechanical injury by injection, followed by the processes of inflammation and replacement, was demonstrated. (BBB)

6743 ON THE CORRELATION BETWEEN ^{40}K CONTENTS IN THE ORGANISM OF MAN AND HIS CONSTITUTION. Sivintsev, Yu. V.; Arutinov, O. M.; Kanareikin, V. A. (Kurchatov Inst. of Nuclear Energy, Moscow). Radiobiologiya, 5: 763-5(1965). (In Russian).

The sensitivity of γ spectrometric measurements for 0.5 to 1.5-Mev γ spectrum lines for emitters within the human body reaches about 10^{-11} C/kg of body weight, corresponding to about $^{1}/_{1000}$ of the MCP of the γ emitters. In view of the ^{40}K content of the muscular tissue, it was attempted to determine the dependence of the ^{40}K concentration on parameters, such as weight, height, and age of man. Previous studies of the authors on the natural activity of the human body (Med. Radiologiya 10, 42(1965) No. 11) did not confirm previously established correlations between the K concentration and the age of the subjects. Other researchers attributed the decrease of ^{40}K content in the body of middle-aged persons to muscular atrophy and to the increase of subcutaneous fat deposits. It was concluded that the variations noted in the earlier literature cannot be explained simply on the basis of age alone. The K content may be more directly correlated to the constitution of the subjects, expressed as weight per height in Kg/cm. The correlation coefficient derived from 188 measurements was found to be 0.95 ± 0.09. (TTT)

6744 EXCHANGEABLE MASS: DETERMINATION WITHOUT ASSUMPTION OF ISOTOPIC EQUILIBRIUM. Bergner, Per-Erik E. (Oak Ridge Inst. of Nuclear Studies, Tenn.). Science, 150: 1048-50(Nov. 19, 1965).

The method of isotope dilution for determining the exchangeable mass of different substances in living organisms is approximate. A formally exact method, defining the concept of exchangeable mass, is proposed. This method may serve as a standard for determining errors in results obtained by the earlier method. (auth)

6745 ^{90}Sr UPTAKE BY PLANTS AS INFLUENCED BY SOIL TYPES AND LIMING. Haghiri, F.; Sayre, J. D. (Ohio Agricultural Experiment Station, Wooster). Soil Sci. Soc. Amer. Proc., 25: 120-3(Mar.-Apr. 1961).

A greenhouse study was conducted to determine the influence of various soil types and liming on the uptake of

^{90}Sr by plants. The soil types tested were Canfield silt loam, Miami silt loam, Brookston silty clay loam, and Ashtabula silt loam. Treatments consisted of four ^{90}Sr levels (0, 11, 22, 44 μC) in combination with two levels of lime (0 and 4 ton/acre) applied to each soil type. Five crops, corn, soybeans, buckwheat, Sudangrass, and alfalfa, were grown in sequence on the four soil types. After ~5 weeks' growth, the vegetative parts of the plants were harvested and ^{90}Sr uptake was determined. There were highly significant differences in the total uptake and concentration of ^{90}Sr by corn, soybeans, buckwheat, Sudangrass, and alfalfa from different soil types and liming. In general, the total uptake of ^{90}Sr from acid Ashtabula, Miami, and Canfield soils was considerably higher than the total uptake from slightly acid Brookston soil. Liming depressed the total uptake of ^{90}Sr by the plants grown on the acid Ashtabula, Miami, and Canfield soils; but had no effect on the total ^{90}Sr uptake by the plants from Brookston soil. These differences appear to be associated partly with the differences in exchangeable calcium and pH of the soils. The accumulation of radiostrontium by the various plant species after 5 weeks of growth was in the order: Buckwheat > soybeans > alfalfa > Sudangrass = corn. The mean total uptake of ^{90}Sr by all crops from the four soils was in proportion to the amount applied to the soils. (BBB)

6746 DECORPORATION OF RADIONUCLIDES (COMPARATIVE INVESTIGATIONS ON DESFERRIOXAMINE B AND DIETHYLENETRIAMINE PENTAACETIC ACID). Nigrovic, Vladimir; Catsch, Alexander (Kernforschungszentrum, Karlsruhe). Strahlentherapie, 2: 283-7(Oct, 1965). (In German).

The retention of ^{144}Ce, ^{91}Y, ^{65}Zn, and ^{60}Co by liver, kidneys, and skeleton of the rat as influenced by desferrioxamine B (DFOA) and diethylenetriaminepentaacetic acid (DTPA) was studied. Whereas DTPA lowered markedly the deposition of all radionuclides, a slight diminution of the retention by DFOA was observed only with ^{91}Y. The deposition of the other radionuclides was unaffected or even enhanced. (tr-auth)

6747 THE METABOLISM OF RADIOPROMETHIUM (^{147}Pm) AFTER INHALATION OF LIQUID AEROSOLS BY MICE. Gensicke, Friedrich; Nitschke, Hermann-Wolfgang (Staatliche Zentrale fuer Strahlenschutz, Berlin). Strahlentherapie, 2: 288-95(Oct, 1965). (In German).

Deposition, resorption, and distribution of inhaled ^{147}promethium-chloride liquid aerosols was investigated in white mice. Compared to ^{91}Y, ^{144}Ce, and ^{143}Pr, radiopromethium, present in this chemical form, is absorbed quickly after inhalation and stored predominantly in liver and skeleton. Within 14 days the major portion of the activity, inhaled through the lungs, is excreted with the feces. The excretion of activity increases considerably from ^{91}Y, ^{144}Ce, ^{143}Pr to ^{147}Pm. The highest activities were found in the lungs 30 days after inhalation. (tr-auth)

6748 ENVIRONMENTAL ^{131}I IN CHILDREN. Wellman, H. N.; Hansen, Warren; Laurer, Gerald; Karches, Gerald; Fooks, Jack (Public Health Service, Cincinnati). pp 27-9 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Partial balance data and thyroid measurements for environmental ^{131}I were obtained for a group of ten children over thirty days. Measured thyroid ^{131}I levels were lower than calculated values by a factor of two. This was an initial study to assess the feasibility of future field studies to relate radiation exposure in man to exposure from environmental sources. (auth)

6949 RELATIONSHIP OF POTASSIUM CONTENT OF MAN WITH AGE AND SEX. RESULTS OF 10,000 MEASUREMENTS OF NORMAL PERSONS; FACTORS INFLUENCING POTASSIUM CONTENT. Oberhausen, Erich; Onstead, Charles O. (Univ., Saarlandes, Hamburg. U. S. Army Medical Research Unit, Landstuhl/Phalz, Ger.). pp 179-85 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

A 2π liquid scintillation whole-body counter was used for over 10,000 measurements of the ^{40}K content in normal persons. The results were used to determine the K content of man in relation to age, sex, body weight, ratio of muscle to lean body weight, and total body water. The maximum K content was found to be 150 gm in males and 100 gm in females, with the K content constant from about age 22 to 50, later decreasing. The relation of lean body mass and fat content to K is discussed. (C.H.)

6750 INTERPRETATION PROBLEMS OF WHOLE BODY POTASSIUM MEASUREMENTS STUDIED ON VARIOUS COMPONENTS OF DISSECTED PIGS. Pfau, Alexander (Max-Planck-Institut, Marlensee, Ger.). pp 186-202 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Conversions of ^{40}K whole-body radioactivity to total body K are based on the fact that ^{40}K has been shown to be present in a constant ratio in naturally occurring K. Gamma activity from ^{40}K in humans or large domestic animals can be measured with large volume detectors. The data will be of little practical value without information on the relation of whole-body K to body composition. Whole-body morphological and chemical analyses of swine have been carried out for over 100 years and data are also now available on the functional body composition based on active protoplasmic mass and metabolic inactive mass consisting of extracellular water, fat, and bone mineral. Swine of the same chronological age differ in gross body composition with different feeding and management practices. Results are reported from an analysis of 61 swine of several breeds maintained under various environmental and feeding conditions for morphological, chemical, and functional body composition. Two selected muscles from 60 swine of different sex and breed were analyzed and compared and all the muscles from one swine were analyzed and compared to the results from selected muscles from 60 swine. Data are presented on gross meat composition of pigs from different sexes and breeds, mean K content as related to the original muscle sample, to fat-free muscle, and to various other meat components. Results indicated that total-body K measurements cannot be related morphologically or chemically to one reference quantity only. (C.H.)

6751 CORRELATION OF TOTAL BODY POTASSIUM AND TISSUE POTASSIUM MEASUREMENTS. Remenchik, Alexander P.; Talso, Peter J.; Miller, Charles E. (Veterans Administration Hospital, Hines, Ill. Loyola Univ., [Chicago]. Stritch School of Medicine, Chicago. Argonne National Lab., Ill.). pp 203-10 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

The accuracy of using ^{40}K whole-body content, as determined by whole-body counting of man, for the estimation of body solids, muscle mass, and total-body fat is questioned. Measurements were made of the ^{42}K content and the ^{40}K content of the same individuals and the $^{42}K/^{40}K$ ratio was calculated for each subject. The lean body mass of these subjects was calculated from their total body water measurements, the lean body mass of K was calculated from these data, and the effect of body fat on the lean tissue content of K, calculated from measurements of K in a whole-body counter, was determined. These data suggest that the accuracy of the measurements of ^{40}K content of man in whole-body counters is affected by the composition of the subject measured and that ^{40}K content should not be used to calculate body fat, body solids, or muscle mass. However, serial whole-body counts of patients during the course of an illness may indicate the existence of a K deficit. (C.H.)

6752 DECREASE AND INCREASE OF POTASSIUM AT DEPLETION OF POTASSIUM. GAMMA SPECTROMETRIC DETERMINATIONS OF THE DISTRIBUTION AND EXCRETION OF THORIUM DAUGHTERS IN THOROTRAST PATIENTS. Kaul, Alexander; Rajewsky, Boris (Max-Planck-Institut for Biophysics, Frankfurt am Main). pp 237-47 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

The calibration of instruments for the determination of the whole-body content of radionuclides depends on the

distribution of the incorporated radioactive material in the body. Potassium and Cs are particularly uniformly distributed in the body, while I, Ra, and ThO_2 accumulate at specific spots. The calibration is described of a total-body γ spectrometer for ^{40}K measurements of the intake and excretion of K in patients on a low-K diet and for use in studies on the distribution and excretion of Th and daughters in Thorotrast patients. Counting results are discussed. (C.H.)

6753 STUDIES ON METABOLISM OF ^{95}Zr–^{95}Nb IN THE RAT BY WHOLE BODY COUNTING. Sastry, B. V. Rama; Weiland, Raymond L.; Bass, Allan D. (Vanderbilt Univ., Nashville). pp 465-78 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

The retention patterns of $^{95}Zr-^{95}Nb$ in the rat were studied by whole-body counting. The biological half time for $^{95}Zr-^{95}Nb$ in the rat was fifteen days. The animals lost 50 percent of the original radioactivity in about 9.5 days. About 35 percent of the dose was retained permanently in the tissues. The distribution of $^{95}Zr-^{95}Nb$ as a function of time (14 days) is described. The concentrations in various organs on the seventy-fifth day after intraperitoneal injection are reported. Bone contained the highest concentration. The transient equilibrium between $^{95}Zr-^{95}Nb$ is disturbed by the rat tissues during distribution. While bone tends to concentrate more ^{95}Zr, the soft tissues show preference for accumulation of ^{95}Nb. The ratio $^{95}Zr/^{95}Nb$ is larger for $^{95}Zr-^{95}Nb$ found in the bones than the ratio $^{95}Zr/^{95}Nb$ in the administered dose. The ratio $^{95}Zr/^{95}Nb$ is smaller for $^{95}Zr-^{95}Nb$ found in the soft tissue than the ratio of $^{95}Zr/^{95}Nb$ in the administered isotope mixture. (auth)

6754 POTASSIUM AND ^{137}Cs CONTENT OF SOUTH AUSTRALIANS AGED 8 MONTHS TO 80 YEARS. Worthley, Boyce (Univ., Adelaide). pp 497-506 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Design features and calibration procedures are described for a moving crystal scintillation system for use in whole-body counting. Results are reported from measurements of whole-body K content, based on ^{40}K measurements, of a group of 16 children, 8 of whom were between 8 and 12 mo. of age, and the ^{137}Cs content of children and adults up to 80 yr of age. The influence of body weight, sex, age, and disease on results of K measurements is discussed. (C.H.)

6755 THE USE OF RADIOACTIVE ISOTOPES IN TUBERCULOSIS RESEARCH. Proceedings of the International Symposium held in Prague, May 14–17, 1963. Pasquier, J. F.; Trnka, L.; Urbancik, R. (eds.). New York, Pergamon Press, 1965. 190p. $10.00. (CONF-630505).

Thirteen papers by representatives of European laboratories interested in research on tuberculosis are presented. The present status and possibilities for the use of radioisotopes in tuberculosis research and techniques for the measurement of β emitters of varying energy are reviewed. Topics discussed include the incorporation of ^{14}C, ^{32}P, and ^{35}S in Mycobacterium tuberculosis and the use of labeled bacilli in studies of experimental tuberculosis in guinea pigs and rats; the dispersion of bacteria in guinea pigs after intracutaneous, subcutaneous, and oral administration; immune reactions to M. tuberculosis; and the reproduction of mycobacterial phage; the use of radioisotopes as tracers for studies of mycobacterial metabolism; the use of ^{131}I-tuberculin in studies of immune reactions; and the use of radioisotopes as tracers in studies of the mode of action of antibiotics and chemotherapeutics in tuberculosis, with emphasis on the effects of streptomycin on protein synthesis in tubercle bacilli. (237 references.)(C.H.)

Radiation Effects on Biochemicals

See also CHEMISTRY — Radiation Chemistry

Refer also to abstracts 6829 and 7474.

6756 (ORNL–3853, pp 111-15) CELL PHYSIOLOGY. (Oak Ridge National Lab., Tenn.).

Results are reported from studies of density-gradient profiles of osmotic phenomena in bacteriophages; the quantum yield for the ultraviolet-induced dimerization of thymine in frozen solution; and the effect of cooling and warming velocity on the survival of frozen and thawed yeast. (C.H.)

6757 INCREASE IN THE BRONCHODILATOR ACTIVITY OF SOLUTIONS OF ISOPROTERENOL ANALOGS BY ULTRAVIOLET IRRADIATION. Luduena, F. P.; Ferrari, R. A.; Strosberg, A. M. (Sterling-Winthrop Research Inst., Rensselaer, N. Y.). Arch. Int. Pharmacodyn., 156: 398-404(Aug. 1965).

Ultraviolet irradiation of solutions of 4-hydroxyphenylisopropylaminoethane (I), 3,4-dihydroxyphenylisopropylaminoethane (II), and 4-hydroxyphenylisopropylaminoethanol (III) increased their bronchodilator activity on the perfused guinea pig lung. The increase in activity of solutions of I by irradiation was too large to be totally accounted for by the synthesis of II and III. It is more likely that another compound with a still greater activity was present in the irradiated solution. Of the possible analogs that might be formed by oxidation of compound II, isoproterenol would be the most active. This would mean that β oxidation has taken place. If OH substitution of the β carbon could occur under irradiation, compound III would also be present in irradiated solutions of I. However, the increased activity of these solutions could not be due to compound III since it had no effect in doses up to 100 mcg. Since compound(s) II and/or III would be the intermediate step(s) in the photoxidative synthesis of isoproterenol from compound I, solutions of compound II and III were irradiated and tested for bronchodilator activity. They were found to be more active than the corresponding unirradiated solutions; uv irradiation had approximately doubled the activity. Although II was more active than III, the irradiated solution of III was considerably more active than the irradiated solution of II. When a solution of II was chromatographed after 4-hr irradiation, isoproterenol could not be identified on the chromatogram. However, when a solution of III was irradiated for 2 hr and chromatographed, isoproterenol was identified. The yield of isoproterenol from the β-hydroxylated monophenol indicates the ease of oxidation at the meta position of the benzene ring. This is in contrast to the low yield and, hence, poor reaction rate of β oxidation starting with I. The results strongly suggest that meta as well as β oxidation occurred as the result of irradiation and that the bronchodilator activity increase was due mainly to the photosynthesis of isoproterenol. (BBB)

6758 HEPATIC METABOLISM OF 1-^{14}C-ACETATE IN NORMAL AND IRRADIATED RATS. Santagati, G.; Slaviero, G. E.; Cultrera, G.; Bosco, G. (Univ. Pavia, Italy). Arch. Sci. Med., 119: 108-16(1965).

The in vivo lever uptake of 1-^{14}C acetate was measured in normal rats and in rats irradiated with 500 R and 1,000 R. Irradiation induced a fall in the utilization of the isotope. The fall was due to a depressed synthesis of the acetone- and chloroform-soluble lipids. (Excerpta Med.)

6759 BIOCHEMICAL EFFECTS OF ULTRAVIOLET LIGHT ON INSULIN. Fiore, Cesare; Dose, Klaus (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik, 2: 340-6(1965). (In German).

Zn-beef insulin was irradiated with 2537 Å uv light at pH 3.0 under nitrogen. The inactivation of the hormone was studied with respect to certain chemical and physical charges. It was shown that all three disulfide bonds of insulin must be destroyed in order to inactivate the hormone. Of the usual amino acids, only tyrosine was significantly destroyed by doses less 150 Einsteins/mol. Dose effect curves for the inactivation of the insulin, for the photoreduction for the disulfide ruptures, and for the general destruction of the cystine and tyrosine residues and the quantum yields were given. The change of the uv ab-

sorption spectra and the electrophoretic behavior of irradiated insulin were described. The results were discussed in connection with the present representation on the effect mechanism of insulin. (tr-auth)

6760 DECREASE IN INTEGRATION OF TRANSFORMING DNA OF HEMOPHILUS INFLUENZAE FOLLOWING ULTRAVIOLET IRRADIATION. Notani, Nihal K.; Goodgal, Sol H. (Univ. of Pennsylvania, Philadelphia). J. Mol. Biol., 13: 611-13(Sept. 1965).

Extracted H. influenzae DNA, carrying the genetic marker for resistance to cathomycin (C DNA) and labeled with ^{32}P, was irradiated at a concentration of 5 μg/ml with a uv germicidal lamp. Competent cells (sensitive to less than 1 μg/ml cathomycin) were labeled with ^{3}H-thymidine and were transformed with the C DNA. The results showed that the transforming activity of the uv-irradiated DNA is reduced to less than 0.1% of the original activity of the cathomycin marker. On the other hand, the irreversible uptake of the donor DNA is similar for both uv-irradiated and nonirradiated DNA's. The sedimentation pattern for lysates from cells transformed with uv-irradiated and nonirradiated DNA's was also examined. In the unirradiated series at zero time, about 80% of the donor DNA active material sedimented slowly and stayed on top of the gradient. The recipient DNA sedimented much faster and had about 20% donor atoms associated with it. After 40 and 60 minutes a maximum of about 70% of the donor DNA taken up irreversibly became associated with the recipient DNA (all the recombinants are generated from those fractions where an association of donor and recipient DNA is observed). Thus, uv irradiation of donor DNA effectively blocks its integration, so that a maximum of about 20% of the donor DNA eventually becomes associated with the recipient DNA. An assay of transforming activity from either lysates or fractions obtained after sedimentation of irradiated DNA gave very few transformants compared to the nonirradiated control. The material which is present in the region of integrated DNA had little or no transforming activity for the cathomycin marker, but it may represent material which is active for other markers. These results show that although the uv irradiation of DNA does not affect its being taken up irreversibly by competent cells, it affects its capacity to become associated with recipient DNA during transforming. Since this association is a likely prerequisite for the recombination to occur, it follows that the lack of this association would give no transformation. This accounts mainly for the poor transforming efficiency of uv-irradiated DNA. (BBB)

6761 STIMULATION OF GLYCOGENOLYSIS BY X-IRRADIATION IN RAT LIVER SLICES IN VITRO: AN ION-MEDIATED EFFECT. Bresciani, F.; Blasi, F.; Puca, G. A. (Univ., Naples). Radiat. Res., 26: 451-64(Dec. 1965).

Irradiation of liver slices in vitro with x-ray doses in the range 10,000 to 100,000 rads stimulates glycogen breakdown. Decrease of glycogen is accounted for by glucose released into the incubation medium. The results indicate that the following series of consequential events takes place after irradiation of liver cells: membrane damage → alteration of ionic fluxes → increase of intracellular Na/K ratio → increase of the level of active phosphorylase → increase of glycogenolysis. (auth)

6762 STUDIES OF DNA OF IRRADIATION-DAMAGED NUCLEOPROTEIN. Bauer, R. D. (California State Coll., Long Beach); Loring, W.; Kurnick, N. B. Radiation Res., 26: 507-18(Dec. 1965).

To study the state of the DNA molecules solubilized by the various stages of dissociation of the nucleoprotein complex, rat thymus DNA which dissolved in various salt solutions was chromatographed on ECTEOLA-cellulose. The chromatography results showed that the DNA solubilized by 0.8 M NaCl was more readily eluted than that solubilized by 1.5 M NaCl, which suggests that the 0.8 M soluble material is of lower molecular weight. Therefore, the smaller DNA molecules apparently dissociate from the protein more readily at low salt concentrations than do the larger DNA species. The DNA isolated from tissues of rats subjected to lethal total-body x irradiation was compared with that isolated from control animals. In the case of the thymus and spleen, differences in the chromatographic profiles and sedimentation coefficients of the DNA indicated degradation occurred after irradiation. In the kidney, no significant changes due to the irradiation could be detected by either of these physiocochemical techniques. No changes in the solubility in salt solutions of the nucleoprotein complex of the kidney were noticed postirradiation. It appears from the fractionation and irradiation studies that degradation of the DNA postirradiation may be at least part of the cause of changes in stability of the important DNA-protein complex. Since the DNA of the radioresistant kidney showed no change, whereas that of the radiosensitive thymus and spleen showed changes closely correlated with irradiation, DNA itself may be quite radioresistant, and x-ray damage to the nucleic acid is more likely the result of indirect effects. (auth)

6763 THE EFFECT OF TOTAL-BODY AND PARTIAL-BODY IRRADIATION ON GRANULOCYTIC ALKALINE PHOSPHATASE IN THE RAT. Robinson, E. (Hadassah Univ. Hospital, Jerusalem); Zakaria, Eliyahu M.; Rachmilewitz, Bracha. Radiat. Res., 26: 527-33(Dec. 1965).

Total-body irradiation in rats is associated with an increase in granulocytic alkaline phosphatase (G.A.Ph.) activity. Depression of ACTH secretion by the administration of cortisone did not prevent this rise. The greatest increase in G.A.Ph. after localized irradiation was obtained by exposure of the upper abdomen. Other areas irradiated were the skull, chest, active bone marrow, and exteriorized intestines. Irradiation of partially hepatectomized rats caused a rise in the G.A.Ph., but less than in irradiated animals with intact livers. Plasma from irradiated donor animals increased the G.A.Ph. of unirradiated animals. It is suggested that the liver regulates granulocytic alkaline phosphatase by the production of a humoral factor. There was no correlation between changes in leukocyte and granulocyte counts and the G.A.Ph. activity. (auth)

6764 INVESTIGATION OF HEMIN CHANGES INDUCED BY γ IRRADIATION OF ITS ALKALINE SOLUTION BASED ON INFRARED SPECTRA. Kotova, E. N. Radiobiologiya, 5: 638-44(1965). (In Russian).

Crystalline hemin isolated from ox blood was used to make up a 0.001M hemin solution in 0.01N NaOH that was given a dose of 30 kr with ^{60}Co gamma radiation. The solution was treated with 0.001M H_2O_2 and allowed to stand in air for 20 days. The altered hemin form (H^1) was separated from the unchanged hemin (H) by extraction with butanol (H^1 is insoluble in butanol). Infrared spectra were taken on each of three parallel samples with the use of KBr as a filler. In determining the structural changes taking place in the altered hemin (H^1), absorption bands in the hemin spectrum were assigned as follows: the intense 1709 to 1723 cm^{-1} band was assigned to the valence oscillations of the C=O carboxy group; the 2866 cm^{-1} band was assigned to the symmetrical valence oscillations and the 2957 cm^{-1} band to the unsymmetrical valence oscillations of the C−H bond in the $-CH_2-$ and $-CH_3$ groups; the 3090 to 3105 cm^{-1} band was assigned to the C−H bond in the CH_2 vinyl group; and the 1624 to 1631 cm^{-1} band was assigned to the C=C group. A study of the spectra based on these assumptions indicated that there were no changes in the −COOH, $-CH_2-$, and $-CH_3$ groups of the hemin altered by irradiation (H'). There were indications that the vinyl group becomes saturated with the formation of a primary alcohol during irradiation. There were possible changes in the porphyrin ring as a result of the irradiation. (TTT).

6765 PERMEABILITY OF ERYTHROCYTE MEMBRANE TO POTASSIUM. III. D'Amore, A.; Marotta, U.; Marsella, A.; Monacelli, R. (Istituto Superiore di Sanita, Rome). Rend. Ist. Super. Sanita, 26: 1007-10(1963). (In Italian).

Radioinduced changes in erythrocyte membrane permeability were studied in vivo using monkeys (Macaca rhesus). The animals received whole-body exposures of 240-kv x rays, 700 R delivered in 30 min. Blood samples were drawn before and after irradiation. Red cells and serum were separated, and Na and K concentrations were estimated by flame photometry in deproteinized and nondeproteinized samples. The Na content of serum after irradiation rose 1.4%, a non-significant change. Serum K concentration increased 23%. In erythrocytes, Na levels showed no post-irradiation changes, while K content declined slightly (3%). These results confirm those found earlier in rabbits, namely, that the permeability of the red cell membrane to K is increased by in vivo irradiation. (BBB)

6766 INACTIVATION OF SEVERAL ENZYMES OF PISUM SEEDS BY γ RADIATION. Sosa-Bourdouil, C.; Sosa, A. (Laboratoire du C.N.R.S., Gif-sur-Yvette, France). Rev. Gen. Bot., 72: 737-49(Apr. 1965). (In French).

The inactivation of α carboxylase by γ irradiation from a ^{60}Co source was measured in pea (Pisum sativum) seeds by its effects on transformation of pyruvic acid. The ^{60}Co source dose rate amounted to 20,000 R/hr. The enzymatic activity was reduced to 37% of the control value by a dose of $\sim 3.4 \times 10^6$ R. The effects were almost the same after irradiation of the seeds in the dry state or after the enzyme was extracted, but this may have been related to the fact that the seeds could not be completely dehydrated. The synthesis of sucrose in pea seeds by uridine-5-diphosphoglucose transglucosylose was also studied after extraction of the enzyme. The enzymatic activity was reduced to 37% of the control value by a dose of ~ 6 or 7×10^6 R. The effects of ^{60}Co γ irradiation on the rate of exchange of ^{32}P between ADP and ATP was also measured. A dose of 1.5×10^7 R reduced the rate of incorporation of ^{32}P into ATP to 37% of a normal control value. The incorporation rate of ^{32}P into ADP was reduced by the same amount when the same amount of irradiation was used. The incorporation of ^{32}P into ATP was studied in seeds permitted to germinate for 5 days. The rate of exchange was greatest during the first 50 hr of growth, but decreased through day 3 and 5. The amount of ^{32}P incorporated increased when the germinating seeds were exposed to from 10^5 to 10^6 R of ^{60}Co γ irradiation. The ribonuclease activity was decreased in germinating seeds by progressively increasing the irradiation exposure from 5×10^4 to 8.2×10^5 R. The activity of the ribonuclease increased with the time of germination. (BBB)

6767 THE INFLUENCING OF SERUM COMPLEMENTS OF RATS BY WHOLE-BODY X IRRADIATION. Schaefer, Hans-Erhard; Schaefer, Annelore; Braun, Heribert (Universitaetsklinik, Wuerzburg). Strahlentherapie, 2: 296-301(Oct. 1965). (In German).

In regard to the depression of antibody production induced by total-body x irradiation, the behavior of the serum complement of the rat (n = 126) was investigated after a single application of 200 R or 600 R. It was found that a significant increase of the complement titer appeared immediately after irradiation and remained constant up to the 13th day after irradiation. Therefore, the inhibition of a complement consuming and cell-destroying immune reaction cannot be caused by a radiation induced reduction of serum complement. (tr-auth)

6768 CHANGES IN THE LIPIDS OF VARIOUS ORGANS OF RATS AFTER WHOLE BODY IRRADIATION WITH LETHAL DOSES OF X-RAYS. I. CHANGES IN THE ADRENAL LIPIDS. Eberhagen, D.; Zoellner, N. (Univ., Munich). Z. Ges. Exp. Med., 138: 581-92(1965).

Three hours after 1500 R total body irradiation adrenal lipids showed a decrease in cholesterol esters and polyenoic acid and an increase in triglycerides. At 24 hours the lipids returned to near normal levels. Subsequently drastic reductions in cholesterol esters and increases in triglycerides and polyunsaturated fatty acids were observed. Phosphatides remained fairly constant. (Excerpta Med.)

Radiation Effects on Tissues

Refer also to abstract 7296.

6769 (AD-624917) THE SEQUENCE OF EVENTS IN RADIATION CARCINOGENESIS: A UNIFYING FORMULATION. Cole, L. J.; Nowell, P. C. (Naval Radiological Defense Lab., San Francisco, Calif.). Nov. 2, 1965. 31p. (USNRDL-TR-930). CFSTI $2.00 cy, $0.50 mn.

A proposed sequence of events in radiation carcinogenesis is presented and illustrated by recent experimental data. First, one or more specific mutations are produced in the target cell, either directly or through an indirect mechanism, viral or otherwise. Tumor development begins when the altered cell, having survived the mutating event, is brought into mitosis by a specific or nonspecific proliferative stimulus. Subsequent tumor progression results from repeated additional mutations in the tumor cells with sequential clonal selection from the altered population. Considerations of radiation carcinogenesis in experimental animals, and presumably in man as well, are discussed. It was concluded that the complex interplay of many factors and mechanisms — indirect as well as direct — in radiation carcinogenesis makes a simple dose-response relationship untenable. (P.C.H.)

6770 (AED-C-04-20) RADIATION EFFECTS ON LIVING TISSUES AND ORGANISMS. Series C: Bibliographies. Stahlhofen, W. (comp.) (Max-Planck-Institut fuer Biophysik, Frankfurt am Main (West Germany)). June 1965. 168p. Dep. mn.

References (563) are given to reports, books, and journals published from 1962 through 1964. Separate author, report number, and subject indexes are included. (P.C.H.)

6771 (BNL-9653) THE ROLE OF SOMATIC MUTATIONS IN AGING. Curtis, Howard J. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT(30-2)-Gen-16. 23p. (CONF-651116-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Symposium on Topics in the Biology of Aging, La Jolla, Calif.

A review is presented on aging in mammals. Cellular aging, mutations and aging, radiations and aging, and actions of mutations are discussed. There is a good deal of evidence indicating that mutations play a dominant role in mammalian aging, and the concept correlated very well with most of the known facts of aging. (P.C.H.)

6772 (EUR-2457.f) APPLICATIONS RADIOBIOLOGIQUES DE LA PHYSIOLOGIE CELLULAIRE. Rapport Annuel, 1964. (Applications of Cell Physiology to Radiobiology. Annual Report, 1964). (Brussels Univ. (Belgium)). Mar. 1, 1965. 58p. Dep. mn.

Research during 1963-1964 had to do mainly with the relationships between nucleic acids and proteins. The mechanism of genetic replication was studied in bacteriophages; the suppressor responsible for immunity inhibits the autonomous replication of the prophage and superinfecting phages of the same immunity by direct action, and not merely by preventing the synthesis of a diffusible substance needed for replication. Research into the DNA-RNA transcription mechanism led to the isolation and characterization of reticulocyte messenger-RNA and produced a clearer picture of the way blood-cells are formed in the course of embryo development. The very earliest stages of development (segmentation, gastrulation, neurulation) were also studied with the object of discovering the exact moment at which the various RNAs are synthesized. It was found that oogenesis is accompanied by the formation of numerous ribosomes and of messenger and transfer RNA, together with substantial DNA reserves in the cytoplasm; all these reserves are used during segmentation of the eggs, and new syntheses occur during the start of gastrulation; this explains why the development of irradiated or hybrid embryos is arrested at the point where differentiation begins. It appears that new ribosomes form during differentiation, and study of their proteins in various adult tissues does in

fact suggest that these tissues are differentiated in the course of ontogeny. Protein syntheses were investigated both under normal conditions (embryos, acetabularia) and under conditions where the synthesis is inhibited by chemical or physical (x ray) agents or by natural inhibitors which may exercise an influence in the normal regulation of protein syntheses. Research on the nature and specificity of antibodies was concerned with two aspects. The first was the structure, genetic determination, and methods of biosynthesis of γ globulins; in particular it was demonstrated that anti-TMV antibodies yield a residue which is mainly N-terminal alanine but that this is replaced by aspartic or glutamic acid if the antigen is TMV thr^+. Secondly, a new gene was revealed which governs the synthesis of 7S γ globulins. (auth)

6773 (EUR-2510.d) DER EINFLUSS DER PENETRANZVERHAELTNISSE MUTIERTER GENE AUF DIE LEISTUNGSFAEHIGKEIT VON POSITIVMUTANTEN. (Influence of Penetrance of Mutant Genes on the Capacity of Positive Mutants). Gottschalk, W. (Bonn Univ. (West Germany)). July 8, 1965. 14p. Dep. mn.

During 1961–1964 four x-ray induced mutant types of Pisum sativum were studied showing a dichotomy or a forking of the stem. In consequence of this an increase of number of pods per plant occurred resulting in an increase in yield. Because of a reduction in penetrance of the mutant genes the dichotomy appeared only in a distinct portion of the plants of these strains. The non-forked modificants showed a strong reduction in yield compared with the forked modificants. The degree of penetrance of the material varied between 22 and 78% during 1961–1964. The reduction of penetrance was a negative factor of the strains; nevertheless, they showed a good yield in comparison with the original line. Therefore, they represent a useful material for plant breeding. (auth)

6774 (ORNL-3853) BIOLOGY DIVISION SEMI-ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1965. (Oak Ridge National Lab., Tenn.). Nov. 1965. Contract W-7405-eng-26. 222p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Separate abstracts were prepared for 25 sections of this report. A list is included of 343 publications during the period covered by this report. (C.H.)

For abstracts of individual sections see: 6696–6701, 6720–6723, 6756, 6775–6787, and 6909.

6775 (ORNL-3853, pp 36-49) CYTOLOGY AND GENETICS. (Oak Ridge National Lab., Tenn.).

Progress is reported in the following cytological and genetic studies: factors controlling persistent intraclonal variations in cell growth rate in Paramecium aurelia; the effects of the stage in the cell division cycle, postirradiation treatment with streptomycin, and postirradiation starvation on the yield of ts mutants of P. aurelia; the temperature-sensitivity of catalase of a temperature-sensitive mutation of P. aurelia; the effect of actinomycin on the formation of polysomes in temperature-synchronized Tetrahymena; mechanisms of ultraviolet-induced mutations of Escherichia coli; repair of ultraviolet damage in Micrococcus radiodurans; the preparation of purified photoreactivating enzyme from commercial bakers' yeast; the lethal effects of ^{32}P incorporated in bacteriophage; variation in the rate of DNA synthesis during the S period in synchronized hamster cells labeled in vitro with ^{3}H-thymidine; patterns of DNA and RNA synthesis in human cells in swirl cultures; the inheritance of erythrocyte esterase variants in mice; the amino acid structure of mouse hemoglobins; the use of spleen weight as a measure of the growth of infused bone marrow cells in irradiated mice; tracer studies of metabolism of polytene chromosomes, spermatogenesis, and oogenesis in the fly, Rhynchosciara angelae, a member of the Sciaridae. (C.H.)

6776 (ORNL-3853, pp 50-3) CHROMOSOME CYTOLOGY. (Oak Ridge National Lab., Tenn.).

Progress is reported in the following studies of chromosome cytology: the dose independence of tritiated-thymidine induced chromosome aberrations in Vicia faba; the effects of 5-fluorouracil deoxyriboside on DNA synthesis in Vicia faba; the effects of actinomycin D and 8-azoguanine on the mitotic index in Vicia faba roots; the formation of chromosome aberrations in seedlings of Vicia faba grown from x irradiated seeds; and problems involved in the maintenance of insect tissue cultures. (C.H.)

6777 (ORNL-3853, pp 54-61) FUNGAL GENETICS. (Oak Ridge National Lab., Tenn.).

Progress is reported in the following studies on fungal genetics: x radiation dose-rate effects on survival and mutation induction in Neurospora conidia; genetic analysis of irreparable x-ray induced mutations in Neurospora; the distribution of adenine-thymine and guanine-cytosine pairs at the mutant site in mutants of Neurospora; the photoreactivation of ultraviolet irradiated Neurospora; and changes in the pool of free nucleosides and nucleotides during the germination and growth of Neurospora conidia. (C.H.)

6778 (ORNL-3853, pp 62-5) DROSOPHILA CYTOLOGY AND GENETICS. (Oak Ridge National Lab., Tenn.).

Progress is reported in studies on Drosophila cytology and genetics. Revision of a detailed catalog of all the genetic material available for studies with fruit flies was continued. Results are reported from studies of crossover suppressing translocations in populations of Drosophila melanogaster. Males were exposed to 4000 R x radiation and mated to marker females and individual females were backcrossed to marker males. The polytene chromosomes of 75 of these arrangements were examined. Data are included from studies on the timing of spermatogenesis in Drosophila with scintillation counting of tritiated thymidine in inseminated females; the effects of chromosome size on the frequency of x radiation-induced nondisjunction; and indicating that the Notch locus in Drosophila is a cistron. (C.H.)

6779 (ORNL-3853, pp 88-92) RADIATION MICROBIOLOGY. (Oak Ridge National Lab., Tenn.).

Progress is reported on studies of x-radiation induced growth inhibition of Escherichia coli; the recovery of irradiated E. coli cells promoted by unirradiated cells; and chromosome replication during vegetative growth in coisogenic strains of Escherichia coli. (C.H.)

6780 (ORNL-3853, pp 93-7) RADIATION IMMUNOLOGY. (Oak Ridge National Lab., Tenn.).

Progress is reported in studies of changes in mouse spleen RNA after immunization with sheep erythrocytes; antigen competition in mice; tissue culture studies of the metabolic activity of plasma cells during antibody response; differences in the antibody-forming potential of primed and unprimed mouse spleen cells in culture as revealed by their recovery from x radiation; the suppressive effect of ultraviolet radiation on antibody formation in spleen cells of mice; and the development of a simple quantitative method to assess the engulfing and degradative potentials of phagocytic cells. (C.H.)

6781 (ORNL-3853, pp 98-101) MAMMALIAN GENETICS. (Oak Ridge National Lab., Tenn.).

Data are presented from studies of the mutation frequency in female mice exposed to a total dose of 50R of x radiation given at a rate of 81R/min; skeletal mutations in the offspring of male mice exposed to a single dose of 600 R x radiation, a total dose of 600 R given in two fractions, or a single dose of 1000 R; the use of x-autosome translocations in locating the x-chromosome inactivation center in mouse chromosomes; the use of ^{3}H-uridine for labeling mouse oocytes; and the standardization of techniques for karyotype analysis in laboratory strains of mice. (C.H.)

6782 (ORNL-3853, pp 102-4) HUMAN CYTOGENETICS. (Oak Ridge National Lab., Tenn.).

Preliminary results are presented for a survey of the somatic chromosomes of wild rodents native to the Oak Ridge area, including the cotton rat, white-footed mouse, and pine mouse. The kinetics of the induction of chromosomal aberrations by tritiated thymidine and ^{14}C-thymi-

dine were studied in Chinese hamster cells in cultures. Electron microscopic studies of chromosomes isolated by means of cysteine hydrochloride treatment gave information on the fundamental centromere pattern. (C.H.)

6783 (ORNL–3853, pp 105-10) AEC-NASA SPACE BIOLOGY PROGRAM. (Oak Ridge National Lab., Tenn.).

The design of a radiation exposure chamber for use in the whole-body exposure of mice to 35- and 57-Mev protons is described. Results are reported from preliminary studies of lens opacification in mice following exposure to 35- and 57-Mev protons. Ground-based experiments were performed in preparation for the biosatellite experiment in 1966 to test the design of packages for Neurospora and Habrobracon, and to provide a preliminary biological assay of the effects of acceleration, impact, and vibrational parameters alone and in combination with low-level γ radiation. (C.H.)

6784 (ORNL–3853, pp 118-27) MAMMALIAN RECOVERY. (Oak Ridge National Lab., Tenn.).

Lymph node weight changes were followed in mice exposed to 950 R x radiation, in irradiated mice treated with 1-, 10-, or 50- million homologous bone marrow cells, in mice given isologous bone marrow, and in normal mice. The greatest lymph node weight increase in homologous chimeras occurred with the greatest cell dose and presumably represented the greatest graft-vs-host reaction. Studies of the hematopoietic response of irradiated mice given isologous or homologous bone marrow injection showed that bone marrow regeneration is not complete even though the animals may show complete recovery to normal values in hematocrit, hemoglobin, reticulocyte, and serum Fe determinations. Recovery in mice given isologous cells was rapid but not complete 132 days after irradiation while chimeras required 200 days to achieve the same amount of recovery and a marked secondary reduction of hematopoietic capacity was observed at the 20- and 40-day interval. Data are included from a study of the effects of temperature on the erythropoietic activity of x irradiated mouse bone marrow cells grown in culture and a histological study of the growth of parental bone marrow in hybrid mice. The animal testing program for bacteria, viruses, parasites, and genetic control of the mouse colony is described and results are included from a quantitative study of the parasitic fauna of radiation chimeras. (C.H.)

6785 (ORNL–3853, pp 128-40) PATHOLOGY AND PHYSIOLOGY. (Oak Ridge National Lab., Tenn.).

Exposure of mouse embryos at 9 to 17 days gestation age to doses of 50 or 150 R x radiation caused no significant antenatal mortality, neonatal mortality, decrease in longevity, or change in the incidence of leukemia or other major diseases in mice observed throughout life and necropsied at death. Megakaryocyte counts and measurements of radioactivity of platelets after injection of $Na_2{}^{35}SO_4$ to rats given single or repeated injections of platelets indicated that supranormal numbers of platelets in the peripheral circulation may inhibit the production of blood platelets. The inhibition was transient and the platelet count returned to normal within a few days. It was shown that platelet size decreases with platelet age. Results are reported from a study of platelet size distribution during the period of acute injury and recovery of rats from a single exposure to 900 R x radiation as an indicator of radiation effects on platelet production and survival. Genetic factors affecting the growth of transplanted bone marrow in mice were investigated. Data are included from studies of the effects of diet and mouse strain on the 30-day mortality of acutely x irradiated germ-free mice. The use of an IBM 357 system for the semiautomatic recording and computer retrieval of mouse breeding data is discussed. The use of IBM data processing cards with a window 1.4 by 1.2 in. gave good results for the storage and retrieval of histologic sections mounted in film. (C.H.)

6786 (ORNL–3853, pp 155-60) BIOPHYSICS. (Oak Ridge National Lab., Tenn.).

Electron spin resonance techniques were used to characterize free radicals in normal seeds and after several physical treatments preliminary to radiobiological studies. Results indicated that application of multiple physical criteria is a prerequisite to comparisons of ESR signals and may discriminate between seemingly identical signals in seeds following various treatments. Either tritiated 5-bromouracil and ^{14}C-thymine or ^{14}C-5-bromouracil and tritiated thymidine were used for preparing doubly labeled DNA for use in studies of uv photoproducts in Escherichia coli. The yield of bromouracil photoproducts was measured at various doses by chromatographic techniques. Results are included from studies of the intracellular repair of DNA in x irradiated Escherichia coli and the effects of uv on vegetative cells of Bacillus megaterium. Studies of the repair of uv damage in E. coli and in bacteriophage resulted in the identification of the v gene in bacteriophage as the mechanism for the excision of dimers. Evidence of DNA transfer in bacterial conjugation is presented. (C.H.)

6787 (ORNL–3853, pp 177-81) PLANT PHYSIOLOGY AND PHOTOSYNTHESIS. (Oak Ridge National Lab., Tenn.).

Wheat seedlings, growing without cell division after heavy γ irradiation of the unsown grain, were used to study leaf senescence before and after treatment with kinetin, Ni salts, or benzimidazole. The deterioration of chloroplasts was used as the criterion of senescence. The effectiveness of each of these three senescence-retarding chemicals was similar in gamma-plantlets and unirradiated leaf tips floated in vitro. Lettuce seeds were soaked and subsequently redried and examined for changes in germination, growth, and the characteristics of native and x-ray-induced ESR signals. Results are reported from histological studies of mitosis in dormant lettuce seeds and studies of energy conversion during photosynthesis in algae. (C.H.)

6788 (ORNL-P-1703) OBSERVATIONS ON VIRAL, CHEMICAL, AND RADIATION-INDUCED MYELOID AND LYMPHOID LEUKEMIAS IN RF MICE. Upton, A. C.; Jenkins, V. K.; Walburg, H. E. Jr.; Tyndall, R. L.; Conklin, J. W. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 47p. (CONF-651038-1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From International Conference on Murine Leukemia, Philadelphia.

Mice of the RF strain treated with ionizing radiation, nitrogen mustard, triethylene melamine, or myleran showed a markedly increased incidence of myeloid leukemia and/or thymic lymphoma, depending on their age, sex, microflora, and physiological state when treated, as well as on the conditions of treatment. Urethane, with or without irradiation, did not affect the incidence of either disease. Myeloid leukemias induced by irradiation were serially transmitted in adult, as well as newborn, recipients by cell-free extracts. Such extracts also increased the incidence of thymic lymphomas. Lymphomas alone were induced by the Rauscher virus. In general, females were less susceptible to the induction of myeloid leukemia than males, which may be attributable at least in part to the effects of estrogen since this hormone inhibits viral transmission of the disease. Germfree mice appear less susceptible to the induction of myeloid leukemia by irradiation than their conventionally reared counterparts, but are no less susceptible to induction of thymic lymphomas. These observations indicate that a complex interaction among host factors and extraneous agents determines the incidence, latency, hematologic type, clinicopathologic features, and transmissibility of murine leukemia, at least in mice of the RF strain. (auth)

6789 (AD–620967) THE EFFECTS OF X-IRRADIATION ON GASTRIC MOTILITY IN THE DOG. Chu, Jen-pao; Shih, Shou-chien. Translated from Sheng Li Hsueh Pao, 24: 220-6(1960). 14p. (FTD-TT-64-910). CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf.

Sublethal doses of x irradiation did not have a pronounced effect on the motility of the empty stomach in dogs. The characteristic changes were increased strength of contraction and rapid recovery. However, a lethal dose of radiation caused a marked change in gastric motility. Immediately after irradiation, gastric motility disappeared.

It was concluded that the extent of the gastric motility alteration may be used as an index to the severity of the radiation syndrome, as a basis for understanding of the nature of the gastrointestinal disturbance in radiation sickness, and eventually for its treatment. (P.C.H.)

6790 (JPRS–33039) SOVIET STUDIES ON RADIATION INJURY AND SCARLATINIFORM FEVER. Translated from Klin. Med., 43: No. 8, 14-18; 119-22(Aug. 1965). 13p. (TT–65-33616). CFSTI $1.00 cy, $0.50 mn.

Two articles are included; one was separately abstracted in NSA. The other article includes information of scarlatiniform fever in Primorskiy Kray. (P.C.H.)

For an abstract of the individual paper see: 6791.

6791 (JPRS–33039, pp 1-8) AUTONOMIC DYSTONIAS IN RADIATION INJURIES AND THEIR TREATMENT. Glazunov, I. S.; Grafov, A. A.; Ivanov, V. A. Translated from Klin. Med., 43: No. 8, 14-18(Aug. 1965).

Radioinduced autonomic dystonias are classified according to autonomic-endocrinal, autonomic-vascular, and autonomic-visceral dysfunctions, and symptoms of each are described. The involvement of higher autonomic centers in the responses of the human organism to irradiation is suggested. The treatment of autonomic dystonias is also discussed. (P.C.H.)

6792 (JPRS–33170) GENETICS. Translation of Genetika, No. 1, 1-207(1965). 276p. (TT–65-33746). CFSTI $6.00 cy, $1.50 mn.

For abstracts of individual papers see: 6793–6797.

6793 (JPRS–33170, pp 211-16) ULTRAVIOLET MICROBEAM IRRADIATION OF THE NUCLEUS AND CYTOPLASM OF CELLS IN AN ANIMAL TISSUE CULTURE DURING VARIOUS PHASES OF THE CELL CYCLE. Sakharov, V. N.; Voronkova, L. N. Translated from Genetika, No. 1, 1965.

The uv radiosensitivity of cells of a reinoculated animal tissue culture was investigated. A study was also made of the blocking effect on division and destruction of the cells following irradiation of a part of the nucleus or cytoplasm during the prophase or one of the interphase periods. The cells exposed to radiation were from a single-layer culture of pig embryo renal tissue. In all phases of the cell cycle, the cell was found to be 50 to 70 times more sensitive to radiation injury to the nucleus than to the cytoplasm. Irradiation of a segment of the nucleus during the interphase blocks mitosis of the irradiated cell. It was concluded that the mechanism for blocking cell mitosis is related to a local injury in the nucleus while the mechanism of inhibition of the process of division when it has already begun is not related to such localization, and therefore the two mechanisms are essentially different. (P.C.H.)

6794 (JPRS–33170, pp 217-25) A HIGH-YIELD MUTANT OBTAINED AS THE RESULT OF ^{60}Co GAMMA IRRADIATION OF COTTON PLANTS. Ibragimov, Sh. I.; Koval'chuk, R. I.; Payziyev, P. Translated from Genetika, No. 1, 1965.

Cotton plants were exposed to ^{60}Co gamma rays in doses of 500 to 3,000 R with a delivery rate of 2 R/sec at different stages of development: 3–4 true leaves, budding, and blooming. A considerably altered constant form of cotton, mutant No. 1, was obtained as a result of irradiation during the budding stage with a dosage of 2,000 R at a rate of 32 R/sec. This mutant was found to be superior in many ways. (P.C.H.)

6795 (JPRS–33170, pp 226-32) THE UTILIZATION OF WINTER WHEAT RADIOMUTANTS IN SELECTION WORK. Mozhayeva, V. S. Translated from Genetika, No. 1, 1965.

The possibility of transmitting individual valuable properties of a mutant through hybridization of the initial variety was investigated. Speltoids that had a productive spike, vitreous grain (up to 20% protein in the grain), and resistance to fungus diseases were used as initial material. In order to transmit these valuable characters a crossing was performed between initial variety PPG 186 and the speltoids. Constant forms were developed with a wheat spike and improved grain quality. It was concluded that the use of mutants by hybridizing them with initial varieties and with one another holds much promise. (P.C.H.)

6796 (JPRS–33170, pp 233-9) USEFUL ARTIFICIAL MUTATIONS OF POTATOES. Solomko, E. A. Translated from Genetika, No. 1, 1965.

Radioinduced mutations of potatoes and their practical applications were studied. The mutants obtained were characterized by a set of valuable, economic characters and can be recommended for direct use in production. Most of the hereditarily altered forms constituted a valuable selection material, although some of them may also be used directly in production. (P.C.H.)

6797 (JPRS–33170, pp 240-8) UTILIZATION OF BEAN AND SOYA RADIOMUTANTS IN SELECTION WORK. Tedopagze, S. G. Translated from Genetika, No. 1, 1965.

Results of investigations on the use of radiation for obtaining varieties of soya and beans are reported. After exposing the plants to certain doses of gamma rays (5 to 10 kR for beans and 7 kR for soya) valuable alterations were obtained. Among the different varieties of soya and beans there were significant differences with respect to radiosensitivity. The best intermutant and variety-mutant hybrids of soya and beans had a higher yield (up to 91%) than their parent forms. Some of the mutants and hybrids obtained are described. (P.C.H.)

6798 STUDIES OF THE MECHANISM OF ULTRAVIOLET ERYTHEMA FORMATION: THE ROLE OF HISTAMINE AND HISTIDINE. Valtonen, Erkki J. (Univ. of Helsinki). Acta Dermato-Venerol., 45: 199-202(1965).

The possible role of histamine in the mechanism of uv-induced erythema in the skin was investigated. The experimental animals were 270 white mice divided into three groups. The first group was given histidine, the second group the histamine-liberator Compound 48/80, and the third group served as controls. Half of the mice were irradiated with short wavelength uv radiation (uv-C) and half with long wavelength (uv-B) uv radiation. Five radiation doses were given. On the external ear the erythemal reaction was recorded on the basis of definite criteria. No significant differences were observed between the three groups of mice. The results indicate that the development of uv erythema is not dependent on the histamine content of the tissue. The erythema response curves obtained with the previous application of both histidine and Compound 48/80 were distinctly similar. In other words, whether the tissue contains histamine in abundance or no histamine does not influence development of erythema. There was no difference between uv-C and uv-B as regards the effect of uv radiation. The explanation could be that although uv-C may cause histamine to form from histidine and the uv-B may cause the release of histamine through tissue damage, the histamine so formed plays no part in erythema formation. (BBB)

6799 TISSUE EOSINOPHILS OF RAT UNDER THE INFLUENCE OF CYSTEINE, LYSINE AND X-IRRADIATION. Holsti, L. R.; Rytoemaa, T. (Univ., Helsinki). Acta Physiol. Scand., 63: 370-6(1965).

Cysteine and lysine were given to rats by stomach tube either alone or before whole-body irradiation, and the tissue eosinophils were counted. Repeated daily administration of cysteine and lysine for a week caused a significant decrease in the eosinophil count of the skin, duodenum, and colon. Short term amino-acid treatment caused no changes in the tissue eosinophil count. Whole-body irradiation alone and after amino acid pre-treatment also caused a significant decline in the tissue eosinophil count. This concurs with observations that long-term treatment with ACTH and cortisone lowers the number of tissue eosinophils. The principal extramedullary amount of eosinophils of the organism is in the tissues. The significance of these cells for the organism is that they constitute one of its defensive and protective mechanisms. There seems to be a relation-

ship between the number of tissue eosinophils and the radioprotective effect of cysteine and lysine established earlier. (Excerpta Med.)

6800 BIOCHEMICAL ASPECTS OF CHROMOSOME BREAKAGE. Kihlman, B. A. (Univ. of Uppsala). Advance. Genet., 10: 1-59(1961).

Radioinduced chromosomal aberrations are reviewed with emphasis on the oxygen enhancement effect. Studies with agents such as respiratory inhibitors and 2,4-dinitrophenol showed that oxidative metabolism is not involved in the oxygen effect. However, a correlation does appear to exist between the influence of oxygen on the production of chromosomal aberration by ionizing radiations and on the production of hydrogen peroxide by the same radiations. The effects of dose rate and dose fractionation on exchange frequency are considered. (H.G.D.)

6801 CHANGE IN THE SEXUAL CYCLE AND THE TREND OF ^{32}P CONCENTRATION IN THE OVARIES DURING REPEATED ADMINISTRATION OF SMALL QUANTITIES OF THE ISOTOPE. Dobrovolskii, L. A. (Inst. of Laboratory Hygiene and Occupational Diseases, Kiev). Akusherstvo Ginekol., 5: 153-4(1964). (In Russian).

It was found that the administration of 2 μC of ^{32}P daily for a year provokes radiation sickness in rats. The content of ^{32}P in the ovaries increased from the time of the first administration up to the 18th day and thereafter, although continuing introduction of the isotope remained constant. In unmated rats the estrous cycle changed: the number of rats with a normal sequence of cyclic changes decreased, the estrous stage became longer, and the proestrous stage became shorter. The number of maturing follicles decreased and in many, the ova perished at various stages of development. (TCO)

6802 RESULTS OF UROLOGIC EXAMINATION IN CASES OF CERVIX CARCINOMA TREATED WITH IRRADIATION. Sallinen, A.; Koulumies, M. I. (Univ.-Frauenklin., Helsinki). Ann. Chir. Gynaecol. Fenn., 54: Suppl. 135, 49p.(1965).

The occurrence of injuries to the bladder and urethra in women treated for collum cancer (161 cases), corpus cancer (30), vaginal cancer (6) and ovarian cancer (9) is reported. The injuries were of very varying types and degrees of severity. In some cases of injury seen in cystoscopy no subjective symptoms were felt (probably overshadowed by the cancer symptoms). In other cases with subjective symptoms no pathological changes were seen at cystoscopy. Many injuries were caused by radiation treatment. Because all patients were not systematically cystoscopized, the figures given may not reflect the true frequency of the various injuries. Methods of treating the injuries (electrocoagulation, instillation of $AgNO_3$ solution, treatment against infection) and of radiation therapy (modified Stockholm method of radium treatment and external x-ray therapy) are described. Results of radiation dose measurements in the bladder are reported. High doses were found to be correlated with severe injuries. (TCO)

6803 DOSE RESPONSE RELATIONSHIPS, PARTICULARLY IN MAMMALIAN RADIOBIOLOGY. Mole, R. H. (Medical Research Council Radiobiological Research Unit, Harwell, Eng.). Ann. Rev. Nucl. Sci., 15: 207-40(1965).

Dose response relations in mammalian radiobiology are reviewed primarily from the point of view that the relations may be quantitative expressions of a set of observations, in contrast to the theoretician's view that the relations are expressions of scientific hypotheses. Practical use of dose response relations, somatic responses to radiation, and cellular responses in vivo are discussed. Responses of the whole animal and delayed responses of mammals are treated. Tables are included on survival parameters for normal mammalian tissues and organs irradiated under various conditions and of the effect of fractionation on oocyte survival and fertility. (L.B.S.)

6804 INVESTIGATIONS ON THE PULMONARY LESIONS INDUCED BY ROENTGEN IRRADIATION. Czarkowska, Daniela (Marie Curie-Sklodowska Univ., Lublin). Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. D, 18: 195-208(1963). (In Polish).

Morphological changes in the lungs of 35 adult Wistar rats were studied after thoracic irradiation with 150-kv x rays. A total skin dose of 3000 R was given in daily fraction of 500 R for six successive days. The radiation was delivered at a dose rate of 31 R/min. Histopathologic examination revealed necrosis of the blood vessel walls in the intra-aveolar septa, with swelling of the cells in the adventitial layer of the larger vessels. Infiltrations of round cells were seen around the necrotic vessels. In some instances the vessel walls were totally destroyed, resulting in microhemorrhages into the pulmonary parenchyma. These interstitial extravasations of blood stimulated the formation of connective tissue, contributing to the late fibrotic picture. Phagocytes scattered throughout connective tissue contained hemosiderin granules. The alveolar epithelium and pleural membranes responded to irradiation by undergoing cellular swelling. The alveolar walls became infiltrated by granulocytes and lymphocytes. The end result of the changes induced by radiation was a fibrotic lung. (BBB)

6805 ECOLOGY OF MICROCOCCUS RADIODURANS. Krabbenhoft, K. L.; Anderson, A. W.; Elliker, P. R. (Oregon State Univ., Corvallis). Appl. Microbiol., 13: 1030-7 (Nov. 1965).

An ecological study of Micrococcus radiodurans indicated that microorganisms possessing the same morphological and radiation-resistance characteristics as that organism could be isolated from ground beef and from pork sausage. Further studies showed that such organisms also could be isolated from beef hides and from water from a creek adjacent to the packing plant from which the meat samples were obtained. Similar microorganisms were not isolated, however, from a limited number of samples of soil, hay, and fecal material. The use of high levels of γ radiation in the initial isolation procedures proved to be advantageous in inactivating most of the other microflora and facilitating the isolation of M. radiodurans. Control experiments indicated that M. radiodurans did not compete well with the microflora present in ground meat, soil, and beef hides. Preincubation before irradiation of meat and soil samples or enrichment culture techniques did not enhance the isolation of M. radiodurans. The presence of M. radiodurans in creek water suggested one possible source of this organism. (auth)

6806 EXPERIMENTAL TUMOR INDUCTION BY PLASTICS FROM THE SURGICAL VIEW. Vollmar, J.; Ott, G. Arch. Klin. Chir., 298: 729-35(1961). (In German).

When small disks of the plastic polypropylene were implanted subcutaneously in rats and the animals were x irradiated with 600 R in three separate doses of 200 R, given in two or three weeks time, the incidence of tumors was 23.6%. The first tumor appeared after a latent period of 11 months. In animals that were not irradiated the tumor incidence was 21.1%. The tumor incidence was reduced to 12.2% in animals from which the implants were removed after 8 months. Tumor incidence was only 1.6% in animals that were implanted with powdered polypropylene. The induced tumors appeared only at the sites of implantation and were generally fibroplastic or polymorphocytic sarcomas. In the dosage given, x irradiation did not seem to have a substantial effect to increase the incidence of skin tumors produced when the synthetic plastic polypropylene was implanted subcutaneously in rats. (BBB)

6807 CYST FORMATION IN RAT LIVERS AFTER INTRAVENOUS RADIOACTIVE COLLOIDAL GOLD. Smith, J. Chandler; Schrier, Bruce. Arch. Pathol., 80: 641-6(Dec. 1965). (COO-78-134).

Intravenous colloidal radioactive gold ^{198}Au produced massive widespread cyst formation in rat livers after a long-latent period. Frequent associated lesions were focal

necrosis and lipoidal degeneration of hepatic tissue. A high incidence of subcutaneous hidradenomas was also noted. The radiogold did not cause cirrhosis, shorten the life span, or potentiate the cirrhosis induced by dietary means. (auth)

6808 THE STATE OF THE BONE MARROW IN CONDITIONS OF ^{90}Sr-INDUCED SARCOMA DEVELOPMENT. Vlasov, P. A. Arkh. Patol., 27: No. 2, 14-18(1965). (In Russian).

In conditions of radiostrontium-induced osteosarcoma development, the bone marrow state is determined not only by the action of β-rays, but also to some extent by the bone tissue changes. The bone marrow changes occur in definite periods of time. The first period is reduction of the cellular elements in the bone marrow of epiphyses and of the adjacent diaphyses areas; the second is the restorative peroid during which the bone marrow passes through the phase of fatty bone marrow; and the third period is that of bone marrow hyperplasia. As established, there exist profound correlative relations between the bone marrow and the bone tissue; evidently the normal bone marrow hemopoiesis appears only with the bone in a normal state. (Excerpta Med.)

6809 THE ACTIVATED LYMPH NODE OF MICE AFTER X-RAY IRRADIATION. Gross, U. M.; Herms, J. (Freie Univ., Berlin). Beitr. Pathol. Anat. Allg. Pathol., 131: 200-19(1965).

In the mouse, the subcutaneous injection of heterologous serum leads to a characteristic modification of the regional lymph nodes accompanied by an accidental cytopoiesis. This phenomenon is examined in the present study by the utilization of x irradiation. Whole-body irradiation of mice (200 and 300 R) causes first a marked diminution of the lymphocytes in the lymph nodes. Subsequent repopulation and restitution of the lymph nodes originates from the small, apparently radioresistant, parenchymal reticulum cells. After serum treatment preceded by irradiation, the radiation reaction in the lymphoreticular parenchyma was unchanged. It was noted however that regeneration occurred earlier, was accompanied by a more marked proliferation of the small and large reticulum cells and that there was also a cellular regeneration in the entire nodal parenchyma analogous to the above-mentioned cytopoiesis. The radiation reaction was markedly diminished when the nodes, which were stimulated by daily serum injections, were irradiated on the fifth day. The cytopoiesis induced by daily injections of serum was not compromised except for a radiation-dependent suppression of mitosis with a corresponding increase in amitotic forms in the stimulated reticular cells. The results obtained under these various conditions are discussed in the light of the known structure of lymphoreticular tissue. (Excerpta Med.)

6810 HAEMATOLOGICAL VALUES IN HIROSHIMA AND NAGASAKI. Hoshino, T. (Atomic Bomb Casualty Commission, Hiroshima). Bibl. Haematol., No. 21, 135-41(1965).

A fixed population composed of ~20,000 exposed survivors of the atomic bombs in Hiroshima and Nagasaki and a nonexposed control population were studied by the Atomic Bomb Casualty Commission. Control and test populations were matched by age, sex, and sociological circumstances. Statistical analysis of routine hematological findings made in the subjects showed no major difference between the exposed and nonexposed groups. The percent distribution and the means of hemoglobin contents are shown by 10 decade age groups of Hiroshima subjects. This demonstrated in the males that the mean of hemoglobin content decreases with age, and that the differences among the age groups are statistically significant. In the females, however, the percent distribution curves of hemoglobin were almost identical in all age groups, except for that over 70 years. The hemoglobin studies done in Nagasaki resulted in similar values to those in Hiroshima. The mean values of hematocrit showed a decrease with advance of age in males, but no such trend was demonstrated in females. Mean values of mean corpuscular hemoglobin concentration by age groups in Hiroshima subjects showed a statistically significant sex difference, but no age difference. There was a statistically significant difference in the mean values of the total white blood cell count between both sexes and in older groups. The mean values were higher in Hiroshima subjects than in those of Nagasaki in every age and sex group. The percentage of white blood cell types showed no significant difference among sex and age groups nor between the two cities. (TCO)

6811 THE MECHANISM OF RADIOSENSITIZATION BY IODOACETAMIDE. Dewey, D. L.; Michael, B. D. (Mount Vernon Hospital, Northwood, Eng.). Biochem. Biophys. Res. Commun., 21: 392-6(Nov. 22, 1965).

Post-irradiation sensitization of bacteria by iodoacetamide was shown in Micrococcus radiodurans and Serratia marcesens given 3 to 4 kR electron beam doses from a 1.8 Mev linear accelerator. Iodoacetamide added 3×10^{-3} sec before irradiation showed the full sensitization observed in long term experiments. However, iodoacetamide added 3×10^{-3} sec or longer after irradiation was completely without effect. Further experiments clearly indicated that iodoacetamide was made toxic by irradiation and that the irradiated iodoacetamide solution could account for the entire radiosensitization. The fact that cysteine removes the radiosensitizing action of iodoacetamide when added to it before irradiation is explained by chemical interaction of the two substances. (H.G.D.)

6812 HAEMOPOIETIC CHANGES IN THE RAT DURING GROWTH AND DURING CONTINUOUS GAMMA IRRADIATION OF THE ADULT ANIMAL. Lord, B. I. (St. Mary's Hospital Medical School, London). Brit. J. Haematol., 11: 525-36(Sept. 1965).

By using autoradiography with tritiated thymidine, the changes in cell proliferation in rat spleen and bone marrow were observed during growth and following continuous irradiation of the mature animal. A ^{137}Cs unit was used to expose rats to 84 rad/day. During growth the spleen was seen to stop its erythropoietic function early in life and a reduced rate of erythropoiesis then followed in the marrow for the rest of the animal's life. Continuous irradiation appeared to produce a reversion of cell proliferation to the original high rates in both tissues. The red-cell output in the adult animal is maintained in spite of a continuous dose of γ radiation which reduces the marrow cell population to 20% of its normal value. Thus, although the animal's lifetime was considerably shortened and death following continuous irradiation at 84 rad/day was due to damage to the bone marrow, the erythropoietic system, at least, seemed capable of responding to this stress until shortly before death. Under continuous irradiation the marrow population is rapidly reduced. The reduction in cell numbers is accompanied by an increase in the labeling index. Labeling in the spleen remains unchanged until the marrow labeling is back to its maximum value, after which the spleen labeling starts to rise. This means that, as the need for greater cell production increases, these two tissues appear to be capable of reversing their growing processes and reverting to a high cell production rate. The changes in cell proliferation following continuous irradiation indicate a narrowing of the distribution of cell cycle times. It is concluded that these changes also represent a reversion of the changes involved in cell proliferation as the animal grows. (BBB)

6813 PATHOLOGICAL CHANGES IN SIX TREATED BABOON-TO-MAN RENAL HETEROTRANSPLANTS. Porter, K. A.; Marchioro, T. L.; Starzl, T. E. (St. Mary's Hospital, London). Brit. J. Urol., 37: 274-84(June 1965).

Six baboon-to-man renal heterotransplants, each consisting of a pair of kidneys, were examined. Two had been removed from their recipients at 49 and 60 days after transplantation because excessive doses of immunosuppressive drug and x radiation were needed to control rejection; the other four pairs of kidneys were examined after death of the recipients at 19, 23, 35, and 49 days. In all cases, splenectomy and bilateral nephrectomy of recipients were performed at the time of renal heterotransplantation. Treatment with Imuran (150 to 200 mg/day) was started two to five days preoperatively and with prednisone (150 mg/day) two to five days before trans-

plantation. After operation the administration of these drugs was continued in high doses. In addition 200 to 400 μg/day of intravenous actinomycin C, and local x irradiation to the transplant (150 R every day for three or four doses) were given either prophylactically or for the treatment of rejection. Pathological findings are reviewed. Evidence pointed to an immunological cause of rejection. (TCO)

6814 SARCOMA INDUCED IN GUINEA PIGS BY X RAYS. **Maggiora, A.; Lilla, J. (Univ., Geneva). Bull. Soc. Franc. Dermatol. Syphiligr., 71: 352-3(May-June 1964). (In French).**

For several months 38 guinea pigs were x irradiated daily on both flanks (100 R on one flank, 200 R on the other). This process was repeated until the death of the animals. A tumor developed on one flank, which had received 60,000 R, in the extension of a cutaneous muscle. The tumor was composed mostly of fusiform cells with polymorphic nuclei. Large, multinucleated cells were also present. A second tumor, also in an extension of a cutaneous muscle, developed after 56,400 R. It exhibited cellular pleomorphism with numerous fusiform cells. The nuclei were strongly basophilic; often the cells were multinucleated. Some cells were elongated, resembling ruptured muscle fibers. Under the influence of irradiation the epidermis atrophied, radioinduced acanthosis developed, and ulcerations appeared and increased in severity. The subcutaneous muscle fibers showed alterations, which progressed to a loss of striation and the appearance of large basophilic nuclei. (BBB)

6815 VAGINAL RESPONSE TO IONIZING RAYS AND CYTOSTATICS. **Guarino, M.; Giarrusso, A. (Univ., Rome). Clin. Obstet. Ginecol., 67: 137-54(1965).**

The significance of the analogies that exist between the vaginal response to ionizing radiations and its response to the so-called radiomimetic substances were examined. An extensive review is presented of the literature in regard to the morphological and biological modifications observed with the two types of therapeutic treatment. Fifteen vaginal smears from patients treated with radiations and 15 from patients treated with antiblastic substances (cyclophosphamide) for malignant neoplasia of the genital apparatus were examined. The cytological study revealed that the specific alterations brought about by the alkylating substances appeared earlier than the alterations caused by the radiation. (Excerpta Med.)

6816 THE MITOTIC CYCLE IN A CELL CULTURE IRRADIATED BY UV. **Terskikh, V. V. (Inst. of Radiation and Physicochemical Biology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 217-20(July 1, 1965). (In Russian).**

Upon exposure to ultraviolet rays, blocks inhibiting the regular mitotic cycles are formed, and there is a decrease in DNA synthesis. Experiments have been performed to determine the connection between these phenomena. Human amniotic cells were exposed to uv rays with a wavelength of 2.54×10^{-4} mm. The cells were tagged with ^{3}H-thymidine and ^{3}H-uridine; the intensity of the nucleic-acid synthesis was determined by the radioautograph method. The length of the phases of the mitotic cycle, the percent of tagged mitoses, and an index of tagged cells were all determined. The first experiments showed that the speed of nucleic-acid synthesis decreases in uv-irradiated cells. The synthesis depends upon the radiation dose. A significant decrease in DNA and RNA synthesis was caused 20 to 30 min after exposure by a dose of 100 erg/mm^2. This effect intensified in the next three hours, then decreased. RNA synthesis returned to normal after 11 hr, DNA after 18 hr. A significant percentage of cells was also destroyed by the 100 erg/mm^2 dosage. Experiments were conducted to determine in which mitotic phase the cells were lethally affected. The cells were incubated with tagged thymidine and fixated at 3 times, before exposure, and 24 and 48 hr after exposure. The decrease in the index of tagged cells was insignificant; tagged and untagged cells perished in approximately equal proportions. The decrease in DNA synthesis and mitotic activity could not be attributed to a predominance of cell destruction in any phase of the mitotic cycle. Cell destruction was discounted in the study of effects on the mitotic cycle of exposure to uv. The results of the several experiments indicated that no block is formed in the G_2 phase, and cells continue to enter mitosis as long as this phase lasts; afterward mitotic activity decreases. At this time DNA synthesis falls sharply. That portion of cells which are tagged at the end of the S phase and are able to complete DNA synthesis up to the moment of irradiation enter mitosis at the usual time. The cells remaining in the S phase due to their lower rate of DNA synthesis are delayed in their advance through the cycle; it is this which leads to the lowering of the mitotic index. Supplementary evidence confirms that uv-exposed cells remain in the S phase. Thus, in a significant portion of cells (those exposed during the S phase), DNA synthesis is not completed, and the cells do not proceed to the G_2 phase. Additional experiments were conducted to study the transition from the G_1 phase to the S phase after uv irradiation. Tagged cells exposed to 100 erg/mm^2 proceeded from the G_1 phase to the S phase at the same speed as unexposed cells. No block arises between the G_1 and S phases. The natural block is, thus, localized in the S phase. In amniotic cells exposed to uv rays, the depression of DNA synthesis occurs almost immediately after exposure, a few hours before the mitotic index falls; depressed synthesis cannot be a result of a block formed in the G_2 phase. Rather, the reduplication of the DNA molecule is a necessary step in the mitotic cycle; it is an incomplete reduplication which prevents the cells from proceeding to the G_2 phase. (ATD)

6817 INCREASED RADIOSENSITIVIY OF THE NERVOUS SYSTEM UNDER THE EFFECT OF FLUOROACETATE. **Minaev, P. F.; Logvinova, O. F.; Mironova, A. P.; Chukhrova, A. I. (Inst. of Biophysics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 235-7(July 1, 1965). (In Russian).**

Previous research has indicated that high doses of ionizing radiation primarily impair the oxidation processes in nerve tissue. In experiments testing this conclusion, the radiation resistance of the nervous system was increased by the use of compounds which protect the oxidation processes from the disruptive effect of the radiation. When arsenic compounds, enzymic poisons inhibiting definite links in the oxidation process, were injected into the cerebellomedullary cistern, it was found that the radiosensitivity of the nervous system increased due to the resulting disruption of the pyruvateoxidase system. Experiments were conducted on dogs to determine the effect of monofluoroacetate on the nervous system. Fluoroacetate is significant in a series of reactions affecting the citric acid cycle. Doses of fluoroacetate (5 μg in 0.5 ml) were injected into the cerebellomedullary cistern 40 to 60 min before the cerebellum was irradiated by the RUP-200 apparatus (radiation doses, 3000 and 8000 R; dose rate, 216 R/min; time, 14 and 37 min). Fifteen and thirty min after irradiation, the amounts of citric, pyrotartaric, and gamma-aminobutyric acids in the tissues of the cerebellum were determined, and the process of oxidative phosphorylation in isolated mitochondria was studied. Radiosensitivity of the nervous system increased under the effect of fluoroacetate. Ordinarily, changes in the functional state begin to occur with a radiation dose of 20 KR; after administration of the poison, functional disturbances were observed after irradiation with doses of 8 and even 3 KR. Large quantities of citric acid were found to have accumulated in the cerebellum; this relates to the disruption of the citric acid cycle. There is also an increase in pyrotartaric acid. The combined effect of the poisoning and irradiation raised the content of gamma-aminobutyric acid, although poisoning alone lowers its content. The consumption of oxygen in isolated mitochondria was somewhat inhibited; utilization of inorganic phosphate was hardly disturbed. Post-irradiation disruption of the cerebellar functions was more severe after poisoning with both fluoroacetate and sodium arsenate. The disruption of the citric acid

cycle is a major cause of the increased radiosensitivity of the nervous system poisoned by monofluoroacetate. The accumulation of pyrotartaric acid may be due either to a direct disturbance by the radiation of the enzyme system responsible for decarboxylating pyrotartaric acid or to the damage done to the citric acid cycle. Irradiation of the nervous system after poisoning with sodium arsenate and fluoroacetate significantly disrupts the pyruvate-oxidase system and the citric acid cycle, two links of the metabolic processes responsible for the radiosensitivity of the nervous system. The experiments reported do not provide any explanation of the disruption of the oxidative phosphorylation process. (ATD)

6818 EFFECT OF IRRADIATION ON THE CELLULAR COMPOSITION OF THE ANTERIOR LOBE OF THE PITUITARY GLAND IN RELATION TO ITS FUNCTION. **Nevorotin, A. I. (Central Scientific-Research, Inst. of Roentgen-Radiology, Leningrad). Dokl. Akad. Nauk SSSR, 163: 998-1000(Aug. 1, 1965). (In Russian).**

In experiments on 100 white female rats of the Wistar line, half of the animals were gonadectomized 15 days prior to irradiation to compare the reactions of overly active pituitary gland anterior lobes with normally functioning anterior lobes of intact animals. The head of each animal was irradiated locally during the oestrous cycle with a 1530 R dose (RUM-3 unit, 180 kv, 17 ma, 0.5 mm Cu and 1.0 mm Al filters, focal length 24 cm, 180 r/min) and the rest of the animal's body was shielded by a 5 mm layer of lead. Animals were killed 7, 10, 15, 30, and 45 days later. The pituitary glands were weighed, fixed and prepared for microscopic examination to determine the number of alpha-, beta-, and delta-cells and chromophobes. Findings show that the irradiation reaction of the pituitary gland anterior lobe in intact and gonadectomized animals is characterized by radiation damage after 7 to 15 days, followed by reparation. However, the shifts in gonadectomized animals are greater, with more significant destruction and reduction of cells followed by a less distinct increase in number of cells. The secretion of the overly active pituitary gland anterior lobe accelerated the radiation damage and the reparative processes, but the lower level of reparation is attributed to more serious damage of the gland. In gonadectomized animals where one function (gonadotrophic) of the anterior pituitary gland was sharply changed, a change in the functional activity occurred not only in the beta-basophilic cells primarily responsible for this function, but also in the other cell types serving other functions. Thus, the state of the functional activity of the pituitary gland anterior lobe largely determines the nature of the irradiation reaction of the gland. (ATD)

6819 DIFFERENTIAL RADIATION INJURY OF PARENT SETS OF CHROMOSOMES. **Prokof'eva-Bel'govskaya, A. A.; Pankova, N. V. (Inst. of Biological Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 1001-2(Aug. 1, 1965). (In Russian).**

Parent sets of chromosomes were investigated in salmon (Salmo salar L.) and groundling (Misgurnus fossilis) fertilized ova in different stages of cleavage to determine radiosensitivity differences. The groundling fertilized ova were irradiated with a 1000 R dose (165 kv, 15 ma, focal length 20 cm, 485 R/min) in the third stage of cleavage, and the salmon fertilized ova were irradiated with an 800 R dose in the fourth stage of cleavage. The irradiated embryos were fixed in the middle and late blastula stages and also the gastrula stage. Chromosome injuries were determined in preparations of crushed stained embryos. In earlier morphological studies of salmon and groundling blastomeres, the dual structure of the nucleus observed in the interphase was found to correspond in the metaphase to two chromosome complexes which remained separate in all developmental stages. In the present study, only one of the two chromosome complexes forming the blastomere nucleus in an irradiated embryo was damaged. In some embryos, the maternal complex with its loosely distributed chromosomes was damaged, and in other embryos the paternal complex with its closely arranged chromosomes was found damaged. These differential radiation injuries of the parental set of chromosomes were observed in the metaphase stage as well as the anaphase-telophase stages. The effects of the initial chromosome breaks, usually of the chromosome and chromated bridges in the bridge-breakage-fusion cycle, were carried through to the blastula stage several cell generations after irradiation. However, the presence of certain types of fragments indicates that some chromosome aberrations are the result of breaks occurring several generations after irradiation. Radiation injury differences of parental chromosome complexes appear dependent on the developmental stage at the moment of irradiation. (ATD)

6820 STUDY OF GAMMA-RAY AND ETHYLENIMINE ACTION ON DIPLOID AND AUTOTETRAPLOID RYE. **Safin, M. K.; Demchenko, V. E.; Levenko, B. A. (Inst. of Botany, Academy of Sciences, Ukrainian SSR). Dopov. Akad. Nauk Ukr. RSR, No. 10, 1380-3(1965). (In Ukrainian).**

Seeds were irradiated in doses of 1, 5, and 10 kr. The incidence of cells with chromosome aberrations in seedlings was the same in diploid and tetraploid rye. With respect to the number of aberrations in the cell and plant growth, tetraploids were stable. The same regularity was observed in experiments with ethylenimine. (auth)

6821 THE ANNUAL SEED RAIN OF ADVENTIVE HERBS IN A RADIATION DAMAGED FOREST. **Wagner, Richard H. (Brookhaven National Lab., Upton, N. Y.). Ecology, 46: 517-20(Early Summer 1965). (BNL-8562).**

Seed rain was measured as part of a long-term study of succession in the chronically irradiated forest facility of Brookhaven National Lab. The forest, a scrub oak-pine-blueberry type characteristic of central and eastern Long Island, was chronically irradiated 20 hr a day by a 9500-C source of ^{137}Cs. By the second summer (1963) all indigenous vegetation was killed up to 20 m and severely damaged up to 50 m from the source, but a few adventive weed species including Erigeron canadensis and Erechtites hieracifolia were found in this 50-m zone. It was assumed that those weeds present in 1963 represented mainly the seed rain of the previous year or two. The study was undertaken to sample the seasonal and numerical distribution of seeds of adventive species entering the forest via wind or bird droppings. Two periods of high seed frequency were found, spring-early summer and late summer-fall, separated by a mid-summer period of low seed frequency. The cumulative total of seeds per species per hectare over the respective period in the late summer-early fall group was determined. Seed sources and successional import are discussed. (H.G.D.)

6822 THOROTRAST TUMORS. QUANTITATIVE STUDIES ON THE DOSE-EFFECT PROBLEM IN THOROTRASTOSIS. **Wenz, W. (Univ., Heidelberg). Ergeb. Chir. Orthopaed., 46: 81-166(1964). (In German).**

The author first reviews the conditions necessary for induction of tumors, including the basic biological effects of irradiation, historical description of radiation tumors, and quantitative relations between dose and tumor induction by radiation. This is followed by a general description of physicochemical characteristics of Thorotrast and its historical use. The advantages and disadvantages of the use of Thorotrast for therapeutic purposes are discussed. The detection of Thorotrast by morphological diagnosis, histochemical procedures, and chemical detection as Th is described. The biological transport and excretion of Thorotrast are described in terms of histological studies of its deposition in organs and factors that affect its removal and excretion. Thorotrast radioactivity, formation and excretion of its decay products, and procedures that can be used to evaluate the irradiation dose received by tissues from deposited Thorotrast are described. The development and characteristics of Thorotrast tumors in animals and humans are discussed. Techniques of x-ray photography, and the limits of Thorotrast burden are discussed, and quantitative relations between Thorotrast burden, tumor incidence, and latency time are evaluated. (430 references.) (BBB)

6823 PHOTOREACTIVATION OF ULTRAVIOLET-INDUCED SUPPRESSION OF DIVISION IN CHILOMONAS PARAMECIUM. Ducoff, H. S.; Butler, Barbara D. (Univ. of Illinois, Urbana). Exp. Cell. Res., 40: 104-11(Oct. 1965). (COO-878-13).

The two phases of division-suppression found after uv-irradiation of Chilomonas paramecium populations were examined for photoreactivability. The second, or delayed, phase was readily photoreactivated whether the tests were run on cultures growing in complete medium, on nitrogen-depleted cells in nitrogen-deficient medium, or nitrogen-depleted cells returned to complete medium. Photoreactivability declined as cells progressed toward division, and could not be demonstrated if PR exposure was performed later than a few hours before the first post-uv division. Photoreactivability was prolonged when division was prevented by nitrogen deprivation. The initial, or immediate, phase of division-suppression was also photoreactivable, but this, for unknown reasons, could only be demonstrated if lag was prolonged by nitrogen-deprivation. The results may be interpreted as indicating that both phases of the division-suppression are the result of uv-damage to DNA, and that there is retention of photoreactivating enzyme complement even under conditions of nitrogen depletion. It is noted, however, that uv may produce photoreactivable lesions in cell constituents other than DNA, and that these may also account for either or both of the two phases of division-suppression. (auth)

6824 SURVIVAL OF ABNORMAL CELLS IN THE THYMUS OF IRRADIATED MICE INJECTED WITH SYNGENEIC BONE MARROW CELLS. Session, J. J.; Stich, H. F. (Queen's Univ., Kingston, Ontario). Exp. Cell Res., 40: 143-5(Oct. 1965).

The effect of syngenic bone marrow injections on the composition of the thymic cell population was studied in mice exposed sub-lethal (1200 rads) whole body x-irradiation. Incidence of karyotypically abnormal cells in the thymuses of mice receiving radiation only was compared with that of mice receiving irradiation plus bone marrow grafts. Results showed that the incidence of mice with abnormal karyotypes in their thymuses was greatly reduced by bone marrow grafts. It is suggested that the inhibitory effect of the grafted bone marrow on x-ray induced leukemias is due to the decreased formation of cells with new genotypes in the thymus. (H.G.D.)

6825 ISOGRAFT RESISTANCE TO ROUS SARCOMAS IN MICE INOCULATED WITH ROUS CHICKEN SARCOMA WHEN NEWBORN. Jonsson, N.; Sjoegren, H. O. (Univ. of Lund, Inst. of Tumor Biology, Karolinska Institutet Medical School, Stockholm). Exp. Cell. Res., 40: 159-62 (Oct. 1965).

Experiments were performed in order to elucidate the question whether Rous virus infection of mice at an age when they are sensitive to the oncogenic effect of the virus might lead to immune responses detectable as virus-neutralizing antibodies and/or isograft resistance. Adult and newborn mice were given 300 to 350 R whole body x irradiation 24 hrs prior to inoculation subcutaneously with 1:5 suspension of Rous chicken sarcoma cells. Two, four, or six weeks after the inoculation of chicken sarcoma material and normal chicken cells, respectively, the animals were challenged with grafts of Rous tumors. Recipients pretreated as newborns with Rous chicken sarcoma cells and developing no primary tumors revealed a clear-cut resistance against isotransplantation of the Rous tumors. The resistance was reflected as a lower frequency of takes among the inoculated animals and as a prolonged latency period and a slower tumor growth. Mice challenged four or six weeks after one injection of the same chicken sarcoma tissue as adults, revealed no transplantation resistance. However, a resistance was found in these animals in one test performed two weeks after pretreatment. (H.G.D.)

6826 ALTERATIONS IN SPINAL CORDS OF NEONATAL RATS FOLLOWING X-IRRADIATION. Rogers, C. H. (Univ. of Arkansas, Little Rock). Exptl. Neurol., 11: 502-15(1965).

The lumbar portions of spinal cords of 3-day-old rats were x irradiated. Neurological, histopathological, and biochemical changes were studied to determine the smallest amount of soft x rays that would induce significant changes by 9 to 11 days post irradiation. All animals receiving 3000 and 4000 R developed paresis or paralysis of the hind limbs by 9 to 11 days. A marked decrease in incidence of grossly visible neurological abnormalities was observed in those animals receiving 2000 R and no abnormalities were seen in the 1000- and 500-R groups. The minimal amount of x radiation needed to produce consistent, severe neurological alterations within this time period was determined to be between 2000 and 3000 R. Microscopical studies of spinal cords from these animals at 11 days following irradiation showed that doses of 2000 to 4000 R reduced markedly the quantity of neuroglia and myelin in the irradiated regions. Those spinal cords receiving 500 or 1000 R appeared to be normal. A dose between 1000 and 2000 R was considered to be the minimal amount needed to produce histopathological changes. Preliminary studies of total lipid and water contents following administration of 4000 R revealed a decrease in amount of total lipid and a greater than normal amount of water in the irradiated zone. This marked decrease in amount of lipid in irradiated spinal cords correlated with a reduction in amount of histologically demonstrable myelin as seen in spinal cords from rats killed at 11 days following irradiation. (Excerpta Med.)

6827 RHYTHM IN ELECTRO-RADIOBIOLOGY. Dernier, Andre. Folia Clin. Int., 13: 533-6(Nov. 1963). (In Spanish).

Evidence is reviewed which indicates the importance of rhythm in bioelectric activity and in radiosensitivity. Stimulation at certain frequencies by both electrical currents and ionizing and nonionizing radiations may be more effective per unit of energy than continuous stimulation or stimulation at other frequencies. Various examples in radiobiology are cited. The retina appears to be sensitive to x rays (70 kv, at 10 ma) delivered at a rhythm of 0.1-sec intervals. The importance of fractionation of radiotherapy in tumor cell sensitivity is discussed. Skin erythema development is different under intermittent and continuous x irradiation. In studies with a rotating source of Ra, providing for alternating shielding, maximum skin erythema was developed at certain frequencies. Seed germination was retarded equally by 900 R doses of continuous x irradiation and 525 R doses of intermittent irradiation of identical quality. In experiments with rabbit skin, epidermatitis occurred 20 days after a 900 R dose of continuous x irradiation but 2000 R intermittent irradiation, provided by a rotating shield, produced only a slight erythema. Depilation of rabbit skin was similar with 1200 R continuous and 2400 R intermittent irradiation. (BBB)

6828 INHERITED HISTOCOMPATIBILITY CHANGES IN PROGENY OF IRRADIATED AND UNIRRADIATED INBRED MICE. Bailey, D. W.; Kohn, H. I. (Univ. of California Medical Center, San Francisco). Genet. Res, 6: 330-40(Nov. 1965).

F_1-hybrid mice derived from a cross of the highly inbred strains: C57BL/6 and BALB/c, were tested for inherited changes of histocompatibility by an orthotopic inter-exchange of tail-skin grafts. The fathers of tested mice received either 522 rads of gonadal x irradiation, or received no irradiation 2 months prior to mating. Thirty-two mice with altered histocompatibilities were found in a total of 2572 complete tests. All of those mutant mice (twenty-one) that produced an adequate number of offspring were shown to pass the incompatibility on to their progeny. Mutants were classified as to whether they effected a gain, a loss, or both a gain and a loss in antigen specificity as determined by whether they rejected skin of donor mice or their skin was rejected by host mice. Twenty-six were clearly of the gain type, five were most likely gain type, and only one showed both a loss and a gain effect. There was no clearcut evidence that loss types had occurred. The preponderance of gain types was tentatively explained as an

artifact of the system used for the assay. Several of the detected mutants were probably from parents carrying mutations that originated in past generations, for some mutant mice occurred in clusters. There was no apparent effect of paternal irradiation (522 rads) on mutation frequency. The induced mutation rate was estimated to be less than 2.6×10^{-5}/gamete/rad. Independent data on isografts from F_1 hybrids of proven non-carrier pedigreed parents provided an estimate of spontaneous mutation rate of 6.75×10^{-3}/gamete. The estimate of doubling dose (greater than 260 rads) was consistent with the estimates for recessive lethals and visibles in mice. (auth)

6829 COMPLEMENTATION AND ENZYME STUDIES OF REVERTANTS INDUCED IN AN AM MUTANT OF N. CRASSA. Pateman, J. A. (Cambridge Univ., Eng.); Fincham, J. R. S. Genet. Res., 6: 419-32(Nov. 1965).

A total of eighty-seven revertants were induced by ultraviolet light in an am^3 strain of Neurospora crassa. All of these revertants appear to be the result of mutation at sites in or close to the am locus. Fourteen of the eighty-seven revertants were partial revertants in that under some conditions of assay they possessed low glutamate dehydrogenase activity compared with the wild-type although their growth rate was similar to that of the wild-type. Enzyme extracts of thirteen of the partial revertants were assayed for glutamate dehydrogenase in various ways in order to establish qualitative distinctions between different kinds of mutant enzyme. Six different groups were established, of which one contained six revertants, one three, and the others one. All except one of the mutant enzyme types showed a marked activation when incubated with α-oxoglutarate plus $NADPH_2$, and all of these had Michaelis constants for ammonium ion much higher than is found for the wild-type enzyme. The remaining group of three revertants gave, at first, no enzyme activity in any of the assay systems. Two of these (the third was not tested) were shown to produce an enzyme variety which becomes quite inactive in phosphate buffer at pH 8.0 but can be fully activated by the addition of ethylenediaminetetraacetic acid. Forced heterocaryons between each of six partial revertants and eleven am mutants were made, and the resultant sixty-six heterocaryons assayed for glutamate dehydrogenase activity. The partial revertants differed among themselves in their complementation characteristics. Some complemented with none of the am mutants, some with am^1 only, and some with am^1 or with am^7. The complementation tests confirmed the differences established by the enzyme studies. The data presented, together with previous work, demonstrate that ultraviolet light induced mutation in an am strain can result in at least eight types of revertant differing from each other in respect of the glutamate dehydrogenase variety which each can produce. (auth)

6830 MUTAGEN SPECIFICITY AMONG REVERSIONS OF ULTRAVIOLET-INDUCED ADENINE-1 MUTANTS OF SCHIZOSACCHAROMYCES POMBE. Clarke, C. H. (Inst. of Animal Genetics, Edinburgh). Genet. Res., 6: 433-41(Nov. 1965).

Ten uv induced mutants at the adenine-1 locus of Schizosaccharomyces pombe differ not only in their intragenic location but also in their spontaneous, HNO_2- and uv-induced frequencies of reversion to adenine-independence. Seven mutants reverted with HNO_2 and of these only two reverted also with uv; the other three did not revert with either HNO_2 or uv. Genetic analysis of revertants showed that they could be due to suppressor mutations at a locus or loci far from the adenine-1 locus, or to events extremely close to, if not identical with, the original site of mutation. Many distant suppressors were found among spontaneous revertants of some adenine-1 and adenine-7 alleles, but such suppressors appear to be less frequent among the five adenine-8 mutants tested. There are large differences between different sites at the same locus in the proportion of their spontaneous revertants due to distant suppressor mutations. Nitrous acid-induced revertants of adenine-1, adenine-7, and adenine-8 mutants were almost all of a type containing no detectable suppressor mutation. In the three cases studied, uv-induced revertants could be either predominantly of a suppressor or non-suppressor type, depending on the particular mutant examined. Striking examples of mutagen specificity were found in which a particular mutant gave mostly suppressor-type revertants with one mutagen, while with another mutagen revertants were mainly of a type containing no detectable suppressor mutation. (auth)

6831 EFFECTS ON GENETIC RECOMBINATION OF ESCHERICHIA COLI K 12 PRODUCED BY ^{32}P DECAY IN THE Hfr MALE. Krisch, Robert (Univ. of Pennsylvania, Philadelphia). Genet. Res., 6: 454-68(Nov. 1965).

The effects of ^{32}P disintegration on the genetic recombination in the Hfr donor cell of Escherichia coli K 12 were studied. The dose-response relationship for the transfer of markers at a distance x from the chromosomal origin was found to hold true to a good approximation for more distal selected markers in the strain, as well as for selected markers of Hfr CS, which transfers its chromosome in the opposite direction. The inheritance by recombinants of non-selected male markers located between the origin and the selected marker is not affected at all by prior ^{32}P dose to the Hfr. The sensitivity of each Hfr strain studied to the lethal effects of ^{32}P decay corresponds to the sensitivity to transfer effects of a male marker located about one-third of the total chromosomal length away from the origin. Genetic and lethal effects in Hfr H showed the same dependence on storage temperature during ^{32}P decay. The data therefore support the concept of a common origin for the lethal and genetic effects of ^{32}P decay. The quantitative predictions of current models for chromosome transfer with regard to radiation mating experiments were examined. Available data on radiation mating experiments preclude exclusion of any of the three models considered. (H.G.D.)

6832 IODINE EXTRACTABLE WITH BUTANOL IN SERUM OF SCHOOL CHILDREN AT PUBERTY WHO WERE EXPOSED TO THE BOMBING AT NAGASAKI WHILE IN UTERO. Burrow, G. N.; Hamilton, H. B.; Man, E. B. (Atomic Bomb Casualty Commission, Hiroshima). Hiroshima Igaku, 16: 252-7(1963). (In Japanese).

Measurement of iodine extractable with butanol in serum (BEI) was made on 249 apparently normal 15-year-old schoolchildren who were and were not exposed to the effects of an atomic bomb while in utero. Girls were superior to boys in growth and development and it seemed that boys were close to the peak of growth stress at puberty. Statistically, no significant difference of BEI was observed between the bombed and non-bombed group. BEI was not decisively influenced in children bombed at 3 months of intrauterine life. Eleven women with struma were analyzed, but no significant difference was found. The average BEI in boys was lower than in girls. Schoolchildren at puberty in Japan had a higher average BEI than those in the middle part of the East Coast of USA and New England. (Excerpta Med.)

6833 THE EFFECT OF IRRADIATION ON THE FEVER OF DELAYED HYPERSENSITIVITY. Allen, Ingrid V. (Queen's Univ., Belfast). Immunology, 8: 475-83(May 1965).

The effect of total-body irradiation on the development of delayed hypersensitivity and on the febrile response to specific antigen was studied in adult guinea pigs. They were divided into three experimental groups: (A) irradiated, prospective hypersensitive donors; (B) nonirradiated, prospective hypersensitive donors; and (C) normal recipients. Animals were irradiated with 200 R doses of 230 kv x rays 24 hr before sensitization with antigen. This dose, when given 24 hr before injection of antigen, was sufficient to suppress antibody formation for 15 days. Donors were sensitized with diphtheria toxin. Although 200 R whole-body irradiation suppressed circulating antibody response, it did not prevent the development of delayed hypersensitivity. Irradiated and nonirradiated hypersensitive animals had an equal febrile response to systemic challenge with specific antigen. Serum from antigen-challenged, irradiated, hypersensitive animals contained a pyrogenic factor of the endogenous serum type capable of producing fever in normal recipients.

These results support the conclusion that production of circulating specific antibody is not essential either for development of delayed hypersensitivity or for the febrile response of the hypersensitive animal to specific antigen. (BBB)

6834 THE EFFECT OF SODIUM CHLORIDE ON RADIATION RESISTANCE AND RECOVERY OF IRRADIATED ANAEROBIC SPORES. Roberts, T. A.; Ditchett, P. J.; Ingram, M. (Low Temperature Research Station, Cambridge, Eng.). J. Appl. Bacteriol., 28: 336-48(Aug. 1965).

The combined effects of salt and irradiation on clostridial spores were studied in such a way as to determine whether the effect of sodium chloride occurred during irradiation, or whether it was manifest only at germination and outgrowth. The organism (Clostridium oedematiens type C and C. sporogenes) were suspended in water in one-ml samples and irradiated by a ^{60}Co source at a dose rate of 1.05 Mrad/hr. Curves of log percent survivors against radiation dose exhibited a small shoulder extending to about 0.25 Mrad before becoming nearly exponential with a decimal reduction (D) value of about 0.15 Mrad. In experiments on the effect of sodium chloride on radiation resistance, the survival curves showed that the presence of neither 3% nor 6% of sodium chloride in the suspension during irradiation had any appreciable effect on the radiation resistances of the anaerobic spores used. The presence of salt during irradiation did not affect the survival curve in either C. oedematiens or C. sporogenes. Results showed that irradiation makes the spores sensitive to the higher salt concentrations at some stage between germination and colony formation. It is concluded that salt concentrations of a relatively low order in irradiated food products may play an important part in inhibiting anaerobic spore development, and that, in combination with radiation, a mild cure may have considerably enhanced inhibitory qualities. (TCO)

6835 RELATIVE FREQUENCIES OF DIFFERENT KINDS OF SPONTANEOUS AND INDUCED MUTANTS OF PNEUMOCOCCI AND STREPTOCOCCI CAPABLE OF GROWTH IN THE PRESENCE OF STREPTOMYCIN. Ravin, Arnold W.; Mishira, Ajit K. (Univ. of Rochester, N. Y.). J. Bacteriol., 90: 1161-73(Nov. 1965).

Mutations conferring ability to grow in the presence of streptomycin arise spontaneously and can be induced in pneumococci and streptococci. They prove to be of several phenotypic and genetic types, which may be classified as follows: VLR, LR, and HR, which confer resistance, respectively, to less than 50, between 50 and 500, and 500 or more μg/ml of streptomycin. VLR and LR mutations recombine with each other, whereas HR mutations generally replace (do not recombine with) several of the VLR and LR mutations. Spontaneously, the VLR type is several times more frequent than the LR and HR types, which are equally frequent relative to each other. Nitrous acid treatment of deoxyribonucleic acid (DNA) in vitro or ultraviolet irradiation of cells tends to produce the VLR and LR type of mutation. Streptomycin-dependent mutations are rare in the pneumococci and streptococci. One such mutation requiring 500 to 1,000 μg/ml of streptomycin for optimal growth, arose spontaneously in a group A streptococcal strain, and was transferred via a DNA-mediated transformation to a pneumococcal strain. In the latter, the mutation proved to be very closely linked to the genetic locus at which the streptomycin-resistance mutations arise. (auth)

6836 PHYSIOLOGICAL ASPECTS OF MODIFICATION AND RESTORATION OF CHROMOSOMAL SYNTHESIS IN BACTERIA AFTER X IRRADIATION. Billen, Daniel; Hewitt, Roger (Univ. of Texas M. D. Anderson Hospital and Tumor Inst., Houston). J. Bacteriol., 90: 1218-25 (Nov. 1965).

A study was made of the effect of amino acid deprivation or chloramphenicol on the character of postirradiation DNA replication in bacteria with the use of radioisotopes and 5-bromouracil as a density label. CsCl density-gradient studies of DNA showed that postirradiation incubation of amino acid-requiring Escherichia coli in an amino acid-free medium interfered with continued linear chromosomal replication. In the presence of the required amino acids, linear chromosomal replication was shown to resume. Addition of chloramphenicol was found to prevent this resumption. Deletion of the required amino acids or the presence of chloramphenicol in a fully supplemented medium allowed the detection of altered DNA synthesis in bacteria at x-ray doses as low as 500 R. The character of the limited DNA made in the presence of the density label after irradiation is described. The results are interpreted as showing that the synthesis of a protein(s) is required for restoration of linear chromosomal replication in the irradiated cells. (auth)

6837 THE SIGNIFICANCE OF POST-IRRADIATION GROWTH IN REGENERATING LIMB AND TAIL BLASTEMAS OF AMBLYSTOMA LARVAE. Pietsch, Paul; Bruce, A. K. (State Univ. of New York, Buffalo). J. Cellular Comp. Physiol., 66: 243-9(Oct. 1965).

Regenerative growth was studied in limbs and tails exposed to x radiation. Significant increases in size were observed following irradiation. Growth eventually ceased in irradiated regenerates and involution set in progressively to claim most of the tissue distal to the amputation plane. This growth was accomplished in spite of severe curtailment of DNA synthesis. On a relative basis the amount of growth was independent of the post-amputation age of the regenerate at time of exposure to x rays. Growth following irradiation showed some dose dependency, but this did not become manifested until after an appreciable time-lag. It was concluded that at any given moment in the history of the salamander limb or tail, there are sufficient numbers of cells capable of forming a blastema without their first having to pass through a phase of high radiosensitivity and that these cells are sufficient to account for the aggregation or enlargement of a blastema, independently of normal proliferation. (auth)

6838 THE ULTRASTRUCTURE OF GERM CELLS IN FOETAL AND NEONATAL MALE RATS. Franchi, L. L.; Mandl, Anita M. (Univ. of Birmingham, Eng.). J. Embryol. Exp. Morphol., 12: 289-308(June 1964).

A study was undertaken to ascertain whether male germ cells undergo ultrastructural changes during the prolonged radiosensitive phase of mitotic inactivity, and, if so, whether these can be correlated with the apparent degenerative changes observed in histological preparations. Male germ cells of fetal and neonatal rats (14.5 days of gestation to 7 days after birth) were examined with the electron microscope. Female germ cells of young specimens were examined for comparison. Mitochondrial distribution in fetal and neonatal cells is described for various times. The possible significance of B-bodies in spontaneous degeneration and high radiosensitivity of gonocytes is discussed. (H.G.D.)

6839 THE ULTRASTRUCTURAL LOCALIZATION OF ACID PHOSPHATASE IN THE CRYPT EPITHELIUM OF THE IRRADIATED MOUSE DUODENUM. Hugon, J.; Borgers, M. (C.E.N., Mol, Belg.). J. Histochem. Cytochem., 13: 524-5(July-Aug. 1965).

The distribution of acid phosphatase activity in the stem cells of duodenal crypts of mice given 1350 R of whole-body irradiation was examined 2, 3, and 5 hr after irradiation. In the duodenal cells of nonirradiated mice, the Golgi apparatus exhibited lead salt deposits (from the substrate used) in some vesicles, but the amount of reaction product varied considerably from cell to cell. A variable number of dense bodies (400 to 600 mμ), two to four per cell, also showed significant amounts of lead phosphate deposit. Discrete precipitate could be observed occasionally in multivesicular bodies, the ergastoplasm and along some cell borders. Two hours after irradiation, lead salt deposition was prominent in many vesicles of the Golgi apparatus. Numerous vesicles (60 to 100 mμ), dispersed in the cytoplasm and sometimes appearing closely related to mitochondria, were filled with the reaction product. Dense bodies also showed a noticeable reaction. Three and 5 hr after irradiation, vesicles and dense bodies containing the reaction product were found inside the cytolysomes. The lead precipitate was sometimes dispersed in these

complex bodies. At this time, there was less precipitate in the Golgi apparatus. These observations reveal a relation between distribution of acid phosphatase, as determined cytochemically, and the development of ultrastructural changes in the irradiated cell. After a period in which activity is very high in the vesicles of the Golgi apparatus and in the dense bodies, the reaction product is confined to the cytolysomes. In these organelles, the membranes of the enclosed vesicles and dense bodies seem to rupture and perhaps, in this way, the enzyme is dispersed in the cytolysomes. (BBB)

6840 MELANOCYTE POPULATIONS IN UV-IRRADIATED HUMAN SKIN. Quevedo, W. C.; Szabo, G.; Virks, J.; Sinesi, S. J. (Brown Univ., Providence). J. Invest. Dermatol., 45: 295-8(Oct. 1965).

Epidermal melanocytes of human skin synthesize increased amounts of melanin pigment after exposure to uv light, but it is generally held that the irradiated melanocytes of human beings do not increase in number. These important conclusions are based on examinations of melanocyte populations visualized by DOPA (dihydroxyphenylalanine) reagent. Further studies were conducted using the relatively low number of DOPA-reactive epidermal melanocytes in the skin of the human buttock. Because of its infrequent exposure to solar irradiation, this site was selected for a further test of the immutability of melanocyte numbers following irradiation. Between 10 and 15 treatments with erythema-producing uv were administered to five patients over a two-week period. The daily doses were graded according to skin tolerance. Twenty-four hr after the last exposure to uv, punch biopsy specimens of skin were removed from the irradiated and contralateral shielded sites. The tanning of the skin observed grossly was accompanied in three out of four cases by a significant increase in the number of DOPA-reactive melanocytes at the dermoepidermal junction. One patient with a high number of melanocytes in the nonirradiated skin showed no significant change in melanocyte number after treatment with uv. The remaining cases showed significant differences between melanocyte populations within the shielded and irradiated sites. The melanocytes of nonirradiated skin showed great variation in their reaction with DOPA reagent. Some melanocytes darkened intensely, others showed only a weak reaction. In contrast, the melanocytes of irradiated skin were more uniformly intensely reactive with DOPA reagent. The irradiated melanocytes often appeared larger and possessed more elaborately developed dendritic processes than nonirradiated melanocytes. Numerous pigment granules were found within the malpighian cells of irradiated skin, but were scarce in those of nonirradiated skin. (BBB)

6841 AUTOSOMAL TRISOMY OF A GROUP 16-18 CHROMOSOME. German III, James L.; Rankin, Joan K.; Harrison, Phyllis A.; Donovan, Denis J.; Hogan, William J.; Bearn, Alexander G. (Rockefeller Inst., New York). J. Pediat., 60: 503-12(Apr. 1962).

The clinical and chromosomal findings in two infants with multiple congenital anomalies are presented. The combination of abnormalities of ear, chin, hands, heart, and nervous system together with the presence of an extra chromosome of Group 16-18 identify the patients as examples of a newly recognized rare trisomic syndrome first described by Edwards and by Patau. Evidence that parental exposure to ionizing irradiation may have had an etiologic role in the chromosomal anomalies is presented for one of these cases. Of the 8 patients so far described in detail, including the present ones, all have had evidence of malfunction of the nervous system, congenital heart disease, a receding chin, and developmental abnormality of ears and digits. Because of the constancy of this array of developmental defects and the similarity of the total clinical picture, it is concluded that this represents a medical syndrome caused by trisomy of one of the autosomes from Group 16-18. Two facts seem of importance in a consideration of the etiology of trisomy of this chromosome of Group 16-18. Parental age is often increased; in the 25 parents from whom data are available there is an average maternal age of 36 and paternal age of 37 years. The parents of Patient 1 described here, however, were not old. X-ray exposure to the parental gonads may also be of importance since in 2 of the reported cases (Patient 1 and one case of an earlier report) the mother had received diagnostic x rays to the abdomen about the time of conception. The parents of both patients had prolonged periods of unexplained sterility. Their somatic cells have no detectable chromosomal abnormalities. (BBB)

6842 INTERACTION OF VACCINIA VIRUS WITH HeLa CELLS AS REVEALED BY ULTRAVIOLET LIGHT IRRADIATION. Oda, Masahiko (Univ. of Tokyo). Jap. J. Exp. Med., 34: 305-13(Dec. 1964).

Before performing the Luria-Latarjet experiment, the capacity of uv-irradiated HeLa cells to support virus growth was tested. Uninfected HeLa cells (8.4×10^5 cells/plate) were irradiated at 2537 Å for various lengths of time and immediately infected with vaccinia virus at 4°C at an input multiplicity of 1.7. Infective center assays of the unirradiated control culture showed that 29% of the cells were virus yielders. About 30% of the cells lost their capacity to support virus growth by irradiation for 20 to 40 sec. The nature of the mechanism responsible for the appearance of the uv-resistant fraction of infective centers remains unknown. The fact that the development of uv-resistance in almost all multiply infected cells coincides with the appearance of the uncoating protein and with the disappearance of morphologically recognizable intact viral forms suggests that acquisition of uv resistance is associated with intracellular stripping of the infecting virus particles. (BBB)

6843 SPLEEN IRRADIATION AND LYMPHOCYTES. Astaldi, G.; Costa, G.; Airo, R.; Duarte, N. (Ospedale Civile, Tortona, Italy). Lancet, 2: 905(Oct. 30, 1965).

Peripheral-blood lymphocytes from patients with chronic lymphocytic leukemia (CLL) generally give a low proportion (7.8%) of blast-like cells after 3 to 4 days of tissue culture with phytohemagglutinin (PHA), whereas blood lymphocytes from healthy persons give high proportions of these cells (68.0%) when cultured in the same conditions. It seems that this defect in blast development shown by CLL lymphocytes depends on a plasma factor, rather than on the innate biology of the leukemic lymphocytes. Development into blast-like cells of blood lymphocytes from healthy persons is inhibited when 5 to 20% of CLL plasma is added to the tissue-culture medium. The proportion of PHA-responsive blood lymphocytes from patients with CLL is increased to the normal values by irradiating the spleen of these patients. The authors observed this effect in 4 such patients, submitted to spleen x irradiation with doses of 300 to 600 R given either in a single dose or in fractionated doses of 80 to 100 R at intervals of 2 to 7 days. Results in a typical case are used to illustrate blast development before and after spleen irradiation in a patient with CLL. Before irradiation the peripheral-blood lymphocytes showed typical CLL behavior (13% of blast cells had developed after 72 hr of tissue culture with PHA). After irradiation of the spleen (480 R administered in 6 doses during 14 days), the proportion of blast-like cells rose to 76%, a normal value. But this effect was transient; the proportions of blast cells began to decrease 3 weeks after the end of irradiation, and reached the values obtained before irradiation after 5 weeks. These results agree with the hypothesis that spleen irradiation removes or destroys that factor observed in the CLL plasma which inhibits the blast development of peripheral-blood lymphocytes. (BBB)

6844 GRASSHOPPER NEUROBLAST TECHNIQUES. Carlson, J. Gordon; Gaulden, Mary Esther (Univ. of Tennessee, Knoxville). Methods Cell Physiol., 1: 229-76(1964).

Various technics (such as specimen collection, rearing, tissue culture) used in cytologic studies of grasshopper neuroblast, especially radiobiology experiments, are described. Methods of irradiation and observation of irradiated cells are reviewed. Certain features of neuroblasts make them particularly advantageous for radiation studies. The closeness of these cells to the body surface

makes them accessible to poorly penetrating radiations such as α, β, and uv radiations. Grasshopper embryos may be exposed to the highly penetrating x and γ rays in vivo, i.e., within the intact chorion of the egg, or in vitro in cultures. Osmotic pressure of neuroblasts changes immediately after exposure to 100 R or more of x rays. Culture medium isotonic to untreated cells is hypotonic to them after irradiation, and an increase in their dia occurs. With ^{32}P, neuroblasts can be exposed to a known amount of β radiation. A method of treating neuroblasts with α particles was developed. Because of the high LET and short paths of α particles, it is necessary to use hanging-drop cultures. A radiation source prepared by electrochemical deposition is described. Neuroblasts can be used for the experimental study of the effects of whole-surface irradiation. Either polychromatic or monochromatic uv radiation can be used to treat the neuroblast. Whole-cell irradiation of hanging-drop preparations of embryos is also described. Parts of the neuroblast can be irradiated with a microbeam of uv radiation. Various technics for detection of modification of radiation effects are also outlined. To determine the effects of pretreatment and posttreatment with heat on x-ray-induced chromosome breakage, eggs are immersed in water at the temperature and for the time desired. The effects of oxygen on the mitotic response of neuroblasts to x rays has been determined by exposing whole eggs to different concentrations of gaseous oxygen as well as to nitrogen or carbon dioxide. Observations on irrradiated neuroblasts can be made on living cells in hanging-drop cultures or on fixed and stained cells. Time-lapse photography has also been used. (BBB)

6845 THE RADIO-NEPHROGRAM IN PATIENTS IRRADIATED DIRECTLY OVER THE RENAL REGION. **Sorrentino, Renato (Istituto Radiologico dell'Ospedale Maggiore, Novara, Italy). Minerva Nucl., 7: 407-11(Oct. 1963). (In Italian).**

Renal function was investigated in 29 patients submitted to radiotherapy in which the kidney was in the radiation beam. The function studies employed ^{131}I-labeled p-aminohippurate (PAH). The tubular maximum reabsorption of PAH (T_mPAH), glomerular filtration rate (GFR), and renal blood flow (RBF) were evaluated. The studies with ^{131}I-PAH employed 30 to 40 μC. The first group of subjects had received total radiation doses to the kidney of 2000 to 4000 R, fractionated over 20 to 30 days. The second group had received 4000 to 5500 R (skin dose), and the third group, up to 8000 R. Renal function appeared to be normal, according to the various tests, in the first group. In the second group, a case of postirradiation hypertensive nephrosclerosis developed with accompanying impairment in renal function. One patient in group three developed unilateral hydroureter with nephrosis 14 months post irradiation, as demonstrated by the tests. The radionephrogram was most useful in detecting either transient or irreversible renal lesions caused by irradiation of the renal parenchyma. (BBB)

6846 MEDICAL RESULTS OF ATOMIC BOMB EXPLOSIONS AND SUGGESTIONS FOR PROTECTIVE MEASURES. **De La Camp, A. Buerkle; Maurer, G. (Berufsgenossenschaftliche Krankenhaus Bergmannsheil, Bochum, Ger.). Muenchen. Med. Wochschr., 103: 208-13(Jan. 27, 1961). (In German).**

The symptomatology of radiation sickness and late lesions is reviewed. The pathological-anatomical changes in various organs are discussed, with emphasis on the alterations observed in the skin, blood-forming organs inclusive of the reticuloendothelial system, and the endocrine glands. The symptoms of radiation sickness become apparent within a few days to several weeks, but the late injuries appear only after months or years. Among the late lesions are leukemia and cataracts, and in these injuries there is an obvious, direct relation between the incidence of morbidity and the distance from the hypocenter of the atomic explosion. The phenomenon of increased keloid formation after irradiation burns is discussed. No definite answer to this problem has been presented yet. The only difference between keloid formation and hyperplastic scar formation is a difference in the number of collagen fibers observed. Probably many factors and mechanisms are responsible for keloid changes. The treatment of keloids and scar contractures is discussed. The authors suggest the establishment of a specialized treatment center and intensive training of surgeons in plastic and reparative surgery. (BBB)

6847 A PHAGOCYTIC FUNCTION OF HASSALL'S CORPUSCLES. **Blau, J. N. (Guy's Hospital Medical School, London). Nature, 208: 564-7(Nov. 6, 1965).**

The presence of carbon particles in Hassall's corpuscles were observed in the thymus of guinea pigs treated either with 300 R x-ray doses or cortisone injections. Hassall's corpuscles in the thymus glands of guinea pigs were shown to take up particles of carbon after the injection of India ink into the circulation. The effect was pronounced in cases of thymic involution caused by x rays or cortisone. It is suggested that macrophages play an important part in the formation of Hassall's corpuscles, which in certain circumstances have a phagocytic function and form a part of the reticulo-endothelial system. (H.G.D.)

6848 TESTS ON DROSOPHILA FOR THE PRODUCTION OF MUTATIONS BY IRRADIATED MEDIUM OR IRRADIATED DNA. **Chopra, V. L. (Inst. of Animal Genetics, Edinburgh). Nature, 208: 699-700(Nov. 13, 1965).**

Studies were made of the rate of both autosomal and sex-linked lethals in the progeny of Drosophila given irradiated food. Induced dominant lethality was also investigated. Food consisting of 10% dried killed yeast, 10% sucrose, and 3% agar in water was irradiated to a total dose of 1 Mrad. Negative results were obtained. There was no evidence for a mutagenic substance being produced in irradiated food. Experiments were also carried out in which 1.8% herring sperm DNA was mixed into the food of Drosophila and Oregon-K flies were allowed to feed and lay eggs on this food. The experiment was repeated three times with negative results. (M.C.G.)

6849 MUTAGENIC EFFECT OF IRRADIATED AND UNIRRADIATED DNA IN DROSOPHILA. **Khan, A. H.; Alderson, T. (Univ. of Cambridge, Eng.). Nature, 208: 700-2(Nov. 13, 1965).**

Experiments were carried out to detect a mutagenic effect of DNA toward Drosophila larvae after the DNA was exposed to a heavy dose of ionizing radiation prior to its addition to a chemically defined and axenic Drosophila medium. Although unirradiated DNA was found to be mutagenic under these conditions, prior irradiation of the DNA did not change its mutagenic effectiveness. (M.C.G.)

6850 LACK OF MUTAGENIC EFFECT OF IRRADIATED DROSOPHILA MEDIUM. **Reddi, O. S.; Reddy, G. M.; Rao, J. J.; Ebenezer, D. N.; Rao, M. S. (Osmania Univ., Hyderabad, India). Nature, 208: 702(Nov. 13, 1965).**

A large-scale experiment was carried out to test the genetic effects of irradiated food on Drosophila melanogaster. Bottles with basic medium containing water, glucose, agar, yeast, and propionic acid in the proportion of 100: 10: 3: 10: 0.4 in grams were irradiated. These bottles were stocked with Oregon-K strain flies. No genetic effects were observed. (M.C.G.)

6851 RADIATION AND THE INDUCTION OF CANCER. **Lindop, Patricia (St. Bartholomew's Hospital Medical Coll., London). New Sci., 28: 500-2(Nov. 18, 1965).**

Studies of radioinduced cancer in rodent populations are reviewed in view of the hypothesis that the observed pattern of tumor induction is related to an induction process and a cell-killing sensitivity. Variations in the dose at which there is maximum incidence of a particular tumor are attributed to the number of hits required to made the change. It is suggested that tedious long-term experiments on animal populations and man are lending themselves to a mechanistic interpretation. (H.G.D.)

6852 INFLUENCE OF TIME FACTOR ON BIOLOGICAL EFFECTS OF X-IRRADIATION ON MICE BEARING

SOLID TYPE EHRLICH'S CARCINOMA. PART II. EFFECT OF DOSES AND INTERVALS ON RESPONSE TO RADIATION. Ogino, Keichiro (Okayama Univ., Japan). Nippon Acta Radiol., 25: 14-21(Apr. 1965). (In Japanese).

Solid type Ehrlich's carcinomas inoculated into the right legs of Cb mice were treated with doses of 10,000 R, 5,000 R, or 2,500 R of x rays at three different fractionations. Treatment with medium dose at intervals of 72 hrs increased survival rate and irradiation at intervals of 24 hrs prolonged the life span in proportion to doses. Three different doses in distributed daily irradiation gave almost the same effect. Tumor sizes were in proportion to dose. In each dose tumor response was greater for irradiation at intervals of 72 hours than for distributed daily irradiation and the most for irradiation at intervals of 24 hours. Examination of the blood 31 days after tumor transplantation disclosed that white cell count was reduced with large doses but red cell count and hemoglobin levels remained higher. Control animals showed marked anemia. Activity of succinic dehydrogenase system of the liver was inhibited in proportion to dose. Based on these findings, it is suggested that widely spaced fractions and adequate doses have advantages such as better tumor response and better general tolerance of the treatment in radiotherapy of malignant tumors. (TCO)

6853 NUCLEAR ENERGY IN AUSTRALIA: IONISING RADIATIONS AND PLANT IMPROVEMENT. Brock, R. D. (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia). Nucl. Energy, 313-15(Oct. 1965).

The radiation work of the Genetics Section of the Commonwealth Scientific and Industrial Research Organization has been largely devoted to a more precise definition of the role and potential usefulness of radiation induced mutations in plants. This work and the genetic techniques are discussed. (L.B.S.)

6854 PHYSIOLOGICAL ASPECTS OF FILAMENTOUS ELONGATED BACTERIA INDUCED BY X-RAY IRRADIATION. Nishii, Satoru (Okayama Univ., Japan). Okayama Igakkai Zasshi, 77: 743-9(Apr. 1965). (In Japanese).

A discussion of the sequences of cytological changes occurring in some bacteria following irradiation indicates that unless the bacteria receive a considerable dose of irradiation, they continue to grow and become elongated, only cell division being inhibited at moderate doses. In the present study, biochemical changes were examined in filamentous Salmonella typhi H901W elongated by culture following after x irradiation (2000 R). It was observed by the Warburg manometric technique that many enzyme activities in the elongated cells were reduced. The induction of an adaptive enzyme for glucuronic acid could not be observed in the elongated cells. In the post-cultures following x irradiation, protein and RNA increased as the cell body elongated but DNA did not increase. This result coincides with the finding that irradiated Salmonella typhi elongated without the increasing of number of nuclear components. In the studies on the agglutination reaction of the elongated cells, it was found that the agglutinability with antibody was reduced and the isoelectric point changed slightly toward a more neutral pH. (BBB)

6855 ALTERATIONS OF THE RECTOSIGMOID IN RADIATION THERAPY OF CARCINOMA OF THE UTERINE CERVIX. I. THE EFFECT OF IONIZING AGENTS ON HUMAN TISSUES, THE CLASSIFICATION AND INCIDENCE OF THE INTESTINAL LESIONS. Savignoni, R. (Univ., Rome). Quad. Clin. Obstet. Ginecol., 19: 520-31(1964).

Review of the literature relating to intestinal radiolesions is presented. Slight changes observable only by endoscopy or histology occur simultaneously with the introduction of radiotherapy. The data concerning early complications depend on the method of investigation and on the sensitivity and individual constitution of the patients. The average latent period may be one month following the beginning of the irradiations. Late complications occur in 2 to 3%, recto-vaginal fistulae develop in 4.3% of the cases. The association of rectal and vesical complications produce symptoms about 8 months after the first irradiation. (Excerpta Med.)

6856 ALTERATIONS OF THE RECTOSIGMOID IN RADIATION THERAPY OF CARCINOMA OF THE UTERINE CERVIX. II. THE ETIO-PATHOGENESIS, AND THE MORBID-ANATOMICAL AND CLINICAL ASPECTS. Savignoni, R. (Univ., Rome). Quad. Clin. Obstet. Ginecol., 19: 593-612(1964).

Infection, particularly with streptococci is an aggravating factor in radiolesion of the rectum. The anterior wall of the rectum is predisposed to ulceration due to its reduced vascularization, whereas fibrosis is more marked in the retrorectal tissue following the thinness and eventual lesions of the perirectal arteries. The small provision of adrenocortical hormones may contribute to the development of perirectal fibrosis. The endoscopic picture varies from a slight hyperemia to a marked atrophy and ulceration following the absorbed doses. Even grave lesions with ulcerations and rectovaginal fistulae may be cured, though recurrences are frequent. The opaque enema serves for the control of the extension of the stricture and for the detection of an ulcer. Rectal ulcer should be differentiated from cancer and syphilitic lesion. The clinical symptoms (pains, diarrhea, rectal bleeding, obstipation) are in direct relation to the anatomical picture. The administration of corticosteroids is a valuable adjunct to the therapy. Grave lesions terminate in cachexia. (Excerpta Med.)

6857 ALTERATIONS OF THE RECTOSIGMOID IN RADIATION THERAPY OF CARCINOMA OF THE UTERINE CERVIX. III. PROPHYLAXIS, TREATMENT AND CLINICAL REPORTS. Savignoni, R. (Univ., Rome). Quad. Clin. Obstet. Ginecol., 19: 629-46(1964).

The importance attributed to the differential diagnoses of radioinduced lesions and cancer is discussed. The mechanism of action of ionizing radiations on living tissues is reviewed. Particular emphasis is placed on relating total dosage and the technique of applying the radiations to the etiology of radiation injuries. Particular reference is made to rectosigmoid lesions secondary to radiotherapy of cervical tumors. A detailed description is given of the clinical manifestations and the various endoscopic and radiological aspects of radiation lesions that may be systematized for didactic purposes. Data from the extensive material of the Obstetrics and Gynecology Clinic of the University of Rome are reviewed. Of 193 cases of cervical cancer in various stages submitted to radiotherapy, the frequency of persistent radiation injuries to the rectosigmoid was 7.72%. It was found that the gravity of the lesions was related not only to the total delivered dose of irradiation but also to technical errors and individual sensitivity. The need for and value of endoscopy plus other investigations is confirmed, ensuring more accurate differential diagnoses from cancer lesions. Photographs of endoscopic pictures illustrate the value of this diagnostic technique. Special procedures of technique and therapy for effective prophylaxis and treatment of the lesions are recommended. (TCO)

6858 EXPERIMENTAL STUDIES ON THE EFFECT OF X RAYS AND γ RAYS ON THE SMALL INTESTINE. Calzavara, F.; Pozza, F.; Zennaro, E. (Univ., Padua). Quad. Radiol., 29: 659-81(1964).

Histologic and histochemical studies were performed on the reactions of the small intestine mucous membrane (duodenum and jejunum), in rats subjected to x and γ radiations (^{137}Cs, ^{60}Co). Doses from 200 to 600 R showed variable effects and a quicker recovery for x radiations compared with gamma. Doses as low as 50 R could be detected histochemically by changes in acid and alkaline phosphatase, and lipase distribution. Some clinical observations are also reported. (Excerpta Med.)

6859 INFLUENCE OF LINEAR ENERGY TRANSFER AND OXYGEN TENSION ON THE EFFECTIVENESS OF IONIZING RADIATIONS FOR INDUCTION OF MUTATIONS AND LETHALITY IN SACCHAROMYCES CEREVISIAE. Mortimer, Robert; Brustad, Tor; Cormack, Douglas V.

(Univ. of California, Berkeley). Radiation. Res., 26: 465-82(Dec. 1965).

The effectiveness of heavy ions with LET values covering the range 45 to 6000 Mev gm^{-1} cm^2 for inducing mutations and lethality in diploid yeast was studied. For all effects, maximum efficiency was observed in the LET range corresponding to boron or carbon nuclei. The oxygen effect decreased with increases in LET, although for one of the reversions an oxygen effect of 2 was found for neon ions. The survival curves remained sigmoid even for the most densely ionizing radiations. For a given amount of inactivation, the probability of recovering mutants among the survivors decreased with increasing LET. (auth)

6860 PRENATAL X-IRRADIATION AND POSTNATAL MORTALITY. Rugh, Roberts; Wohlfromm, Marlis (Columbia Univ., N. Y.). Radiation. Res., 26: 493-506 (Dec. 1965).

A total of 1265 pregnant mice were x-irradiated at various stages of gestation to determine the $LD_{50/30}$. When the mouse embryo was x-irradiated during its first 5 days of development to doses ranging from 125 to 400 R, the litter sizes were reduced so much that it was impossible to derive an $LD_{50/30}$ for the survivors. Most of those that came to term survived this 30-day period well. In utero mortality during the first 5 days after conception exceeded by far the incidence of congenital anomalies, indicating these to be the stages of all-or-none reaction to the irradiation. Results indicated that x rays are not differentially selective with respect to mortality of one sex over the other when exposed in utero, except possibly on gestation day 8. Empirical studies were made on seventy-two sets of accurately timed pregnancies with x-irradiations from gestation day 6 through 18. The postnatal $LD_{50/30}$ was established for each gestation day, i.e., the x-ray dose for each gestation day that resulted in half of the mice born dying within the first 30 days after birth. The X-ray exposures ranged from 120 R to 610 R and were not curvilinear, nor related to gestational age, but rather fluctuated with respect to certain developmental stages. The LD_{50} for the embryo in utero on gestation days 6, 7, and 8 was exactly the same as the postnatal $LD_{50/30}$ dose level to the embryo. Hence, a net survival of 25% at the end of the first 30 days of life of those x-irradiated on days 6, 7, and 8 was found. Early postnatal deaths were more frequent among those x-irradiated at early gestation ages than among those x-irradiated at later gestation ages. For mice of gestation ages 6 to 15 days (corresponding to approximately 12 to 54 days for the human embryo) the majority destined to die did so within 48 hours of birth. Those x-irradiated on gestation days 6, 10, 11, and 13 showed almost the complete 50% expected mortality within the first 48 hours after birth. After 8 days of gestation the x-ray dose necessary to kill 50% after birth was considerably less than the dose necessary to kill the embryos in utero. Neonatal deaths that followed early embryonic x-irradiation were most frequently associated with exencephaly, microcephaly, hydrocephaly, and anemia. Appendage anomalies occurred after exposures on days 11 and 12, and persistent amnions occurred most frequently after x-irradiation on days 11 to 13. (H.G.D.)

6861 ANALYSIS OF DNA SYNTHESIS AND X-RAY-INDUCED MITOTIC DELAY IN SEA URCHIN EGGS. Rao, Bhashini; Hinegardner, R. T. (Univ. of California, Berkeley). Radiat. Res., 26: 534-7(Dec. 1965).

Low doses of x-irradiation delayed the onset of mitosis in the sea urchin egg. The delay was the consequence of a delay in some G_2 process, probably the beginning of chromosome condensation, and was not the consequence of a delay in DNA synthesis. (auth)

6862 INCREASE IN RADIOSENSITIVITY TO IONIZING RADIATION RELATED TO REPLACEMENT OF THYMIDINE IN MAMMALIAN CELLS WITH 5-BROMODEOXYURIDINE. Dewey, W. C.; Humphrey, R. M. (Univ. of Texas, Houston). Radiat. Res., 26: 538-53 (Dec. 1965).

Chinese hamster cells were treated with 5-bromodeoxyuridine (labeled with ^3H) under conditions to obtain either single- or double-strand labeling of the DNA. The cells were irradiated with ^{60}Co γ-rays and were fixed 6 hours later for analysis of chromosomal damage in metaphase cells; the 6-hour time interval selected metaphase cells that were primarily in the latter part of the S phase at the time of irradiation. The amount of BUdR incorporated into these metaphase cells was determined by counting the grains in autoradiographic film covering the cells. Both potentiation and synergistic effects were observed between the radiation and BUdR treatments, and the amount of chromosomal damage increased with the amount of BUdR incorporated into the cells. Even for variations in incorporation that occurred within a given sample, which was treated with one concentration of BUdR for a certain period of time, the cells with more incorporation sustained more chromosomal damage. Also, the long arm of the X chromosome both incorporated more BUdR and was sensitized more than the short arm. The aberration frequency in unirradiated cells (0.08) did not increase until 25% of the thymine was replaced with BU. At this level of incorporation, cells irradiated with 250 rads sustained 1.3 aberrations per cell, whereas 250 rads to normal cells induced only 0.4 aberration per cell. At the same incorporation levels double-strand labeling was no more effective than single-strand labeling. Evidence is presented relating to the hypothesis that radiosensitization after BUdR treatment is attributable to replacement of T with BU. (auth)

6863 RADIOSENSITIVITY OF γM ANTIBODY RESPONSE IN MICE INJECTED WITH KILLED INFLUENZA VIRUS. Berlin, Byron S. (Univ. of Michigan, Ann Arbor). Radiat. Res., 26: 554-66(Dec. 1965).

X-irradiation one or more days before injection of killed influenza virus depressed γM antibody titers, and HI titers at 4 days presented the most sensitive indication of such damage. The high degree of sensitivity of γM formation to radiation was indicated by a D_{37} value of 74 R, absence of a threshold dose of x-ray, and absence of repair of direct injury to γM production. Evidence was also presented suggesting that γM production was more radiosensitive than γG production and that early γM antibody is formed principally in the spleen. In addition, the x-ray inactivation curve for γM production was of the single-hit type. (auth)

6864 THE EFFECT OF ESTRADIOL AND ESTRIOL ON THE SURVIVAL OF SUBLETHALLY AND LETHALLY IRRADIATED MICE. Thompson, John S.; Reilly, Richard W.; Crawford, Margaret; Russe, Henry P. (Univ. of Chicago, Ill.). Radiat. Res., 26: 567-83(Dec. 1965).

Mechanisms of estradiol and estriol injury were studied in x-irradiated mice. Estradiol, and to a lesser degree estriol, administered after sublethal or lethal irradiation for a period of 2 weeks resulted in decreased survival of the recipients. This phenomenon is associated with a failure of recovery of the peripheral leukocyte, and neutrophile counts in the estradiol-treated recipients, and a slower recovery in the estriol-treated recipients. There was no effect on the hematocrit throughout the same period of observation. Examination of the organ weight and microscopic features of the thymus, spleen, lymph node, and liver of lethally irradiated mice revealed that the recovery of both central and peripheral lymphoid tissues is generally impaired in the hormonally treated animals. Since estradiol did not appear to affect lymphatic tissue other than the thymus in the intact adult animal, the failure of peripheral recovery in lethally irradiated mice may be in part mediated through its thymic involutional property. A more direct effect, however, on stem cell proliferation cannot be excluded. (TCO)

6865 TESTICULAR DAMAGE RESULTING FROM ACTINOMYCIN D, X-RADIATION, AND THEIR COMBINATION IN CAF MICE. Maddock, Charlotte L.; Rev-Kury, Livia; Brown, Barbara L. (Harvard Medical School, Bsoton). Radiat. Res., 26: 584-92(Dec. 1965).

Enhancement of the damaging effect on CAF mouse testes when actinomycin D at 75 or 150 μg/kg is added

to x-radiation doses of 300 or 600 R is reported. The addition of this antibiotic caused no significant decrease in weights of irradiated testes, but when more sensitive parameters were employed, alterations indicative of increased atrophy were demonstrable. Actinomycin D, when added 1 hour after x-ray exposure, intensified but did not alter the character of the histological lesions. Definite histological changes occur in the testicle of the mouse as a result of the administration of one intraperitoneal dose of actinomycin D at 150 μg/kg. (auth)

6866 CHANGES IN THE INTESTINAL FLORA OF PATIENTS GIVEN RADIOTHERAPY FOR TUMORS OF THE UTERINE CERVIX. Zanetti, M.; Schiavi, G. F. (Univ., Bologna). Radiobiol. Radioterap. Fis. Med., 19: 291-304(1964).

Modifications were studied in the intestinal flora of 18 female patients under treatment at the Bologna Radium Institute for neoplasia of the uterine cervix. Nine were treated with radium therapy and conventional roentgen therapy and nine with telecobalt therapy. A series of bacteriological tests were carried out on the feces of the patients prior to, during, and at the end of the radiation cycle. The results revealed: an increase in the overall bacterial content in 61.11% of the samples analyzed; an increase in the coliform bacteria in 66.66%; and an increase in the staphylococci in 72.22%. Changes likely occur as a result of the anatomical and functional alterations taking place in the intestinal wall and of environmental changes. (TCO)

6867 BLOOD COAGULATION AND QUALITATIVE CHANGES OF FIBRINOGEN BY EXPERIMENTAL ACUTE RADIATION SICKNESS. Ponomarev, Yu. T. (Inst. of Medical Radiobiology, Obninsk, USSR). Radiobiologiya, 5: 681-4(1965). (In Russian).

Dogs were given a single, whole-body, x ray dose of 800 R, and rats were given a ^{60}Co dose of 600 R. Blood samples were tested for coagulation time, plasma tolerance to heparin, concentration of fibrinogen, fibrinolytic activity (euglobulin time), fibrinogen B, thermal fibrinogen stability, and type of fibrinogen clot. In the dogs the clotting time decreased from 8 min before irradiation to 5 min 1 day after irradiation, and increased to 16 minutes 7 days after irradiation. The fibrinolytic activity varied in a similar fashion with the onset of severe radiation sickness. A parallelism was observed between the level of fibrinogen B, the thermal fibrinogen stability, and type of fibrinogen clot. On the 7th day of radiation sickness, short thick strands with numerous constrictions that break up readily were observed in the clot structure. The increased fibrinolytic activity of the blood with the decreased clotting ability of the blood can partly explain the hemorrhagic syndrome observed during severe radiation sickness. (TTT)

6868 DEPENDENCE OF RADIOSENSITIVITY OF PLANTS ON THEIR PHYSIOLOGICAL STATE. Batygin, N. F.; Misuk, L. A. (Agricultural-Physics Inst., Leningrad). Radiobiologiya, 5: 738-43(1965). (In Russian).

Tobacco and lettuce plants were given gamma doses of 100, 200 and 500 R after determining the dry weight and respiration intensity of the plants. The more intense the respiration, the weaker was the effect of the irradiation. The Mexican kidney bean was grown in a mineral nutrient solution lacking one or more elements, and then was given a dose of 500 R. The replacement of potassium by toxic lithium led to the death of the plant. The replacement of Ca by Sr had no effect on the plant. The elimination of calcium did not lead to a decrease in yield, but did give a decrease in the average seed weight. Potassium decreases the viscosity of the protoplasm, and calcium increases this viscosity. Hence, the presence of these two elements has an effect on the amount of bound water in a cell and on the onset of plasmolysis. The higher the content of bound water, the smaller is the reaction to irradiation and the higher is the radioresistance of the plant. If winter wheat is hardened by lowering the temperature before irradiation, it becomes more radioresistant. Hardening increases the water retention of biocolloids in the plant. Adaptation of a plant to some factor increases its resistance to other factors in many cases. (TTT)

6869 A DEVICE FOR LOCAL IRRADIATION OF ANIMAL CELLS WITH α MICROPENCILS. Vainson, A. A. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 752-6(1965). (In Russian).

A polonium-210 source containing 7 mc of activity/mm^2 spread over a surface diameter of 1.3 mm was mounted on a microscope in order to irradiate the different parts of an individual, living cell. The most suitable method of boring the small opening in the collimating diaphragm was the use of an ion beam. The first working diaphragms were made of tantalum 3 mm in diameter and 0.1 mm thick. The exit opening had a diameter of 1 micron and an angle of taper $(D_{max} - D_{min})/2h = 0.83$. This diaphragm would give an alpha beam 8 to 9 microns in diameter. The angle of taper was further reduced to 0.2 by drilling through two foils in series with the ion beam. With a reduction in the dimensions of the alpha source it was possible to obtain an alpha beam 4 microns in diameter with the use of the improved diaphragm. A photograph of an alpha beam 6 microns in diameter is presented. The equipment was used to study the role of damage to the nucleolus and to the cytoplasm in disturbing DNA synthesis in HeLa cells. (TTT)

6870 ON THE STATE OF ELECTROLYTIC METABOLISM INDUCED BY ACUTE INJURY WITH ^{210}Po. Moroz, B. B.; Grozdov, S. P. Radiobiologiya, 5: 759-61(1965). (In Russian).

Male rabbits, 3 kg in weight, were subcutaneously given 0.1 mC of ^{210}Po per kg of body weight, causing severe radiation sickness with 100% mortality on the 20 to 30th day after administration. The K content of the blood serum increased from a normal value of 16 to 17.2 mg% at 7 days, 18.2 at 14 days, and 24 mg% at 20 days after dosage. The sodium content in the serum also increased from a normal value of 291 mg% to a value of 346 mg% on the 20th day after administering the ^{210}Po. The K/Na ratio in various tissues decreased in a regular fashion. Thus, in the skeletal muscle the K/Na ratio decreased from a normal value of 10.1 to a value of 6.6 on the 20th day after dosage. In the spleen, the K/Na ratio fell from a normal value of 5.7 to 3.3 on the 20th day. The high internal doses from ^{210}Po caused sharp changes in the electrolyte exchange. (TTT)

6871 SPECIFIC PECULIARITIES OF DESOXYCYTIDINE EXCRETION IN NORMAL AND IRRADIATED ORGANISMS. Tereshchenko, O. Ya.; Skurikhina, M. M. Radiobiologiya, 5: 761-3(1965). (In Russian).

The following animals were irradiated with ^{60}Co γ radiation at doses, as indicated: 7 dogs at a dose of 400 R, 6 rabbits at a dose of 800 R, 12 rats and 100 mice at a dose of 700 R. The deoxycytidine (DC) content of the urine was determined by a Dische reaction, as modified by Stumpf. Paper chromatography was used in a number of experiments to improve the accuracy of the results which showed that insignificant amounts of DC were present in the urine of dogs, mice and rabbits. The rats showed a 20-fold increase in the DC content of the urine after irradiation. These results were confirmed by running additional separations by paper chromatography with known amounts of DC, and determining the characteristic maximum at 490 mμ. Only in rats does the excretion of DC serve as an indicator of radiation damage. (TTT)

6872 DYNAMICS OF CONDITIONED REFLEX ACTIVITY DISTURBANCES IN DOGS BY ACUTE RADIATION SYNDROME. Popov, A. V. Radiobiologiya, 5: 766-8 (1965). (In Russian).

In view of the importance of nerve mechanisms for the development of the acute radiation syndrome, the role of the higher nerve centers in the pathogenesis of disturbances caused by large radiation doses was investigated. Mature male dogs were exposed to the γ radiation of a ^{60}Co source and the conditioned defensive reflexes were measured 8 to 24 minutes after irradiation. Significant changes were found in the reflexes and in the latent period of their development. The cortical compensatory mecha-

nisms continued to function for a while; during this period the type and the extent of higher nervous activity was examined. The conditioned reflex activity was completely stopped within 65 to 93 hours after exposure to 15 kR, within 57 to 70 hours after exposure to 25 kR and 1.8 to 32 hours after exposure to 50 kR; at the same time a convulsive syndrome appeared. The length of the survival period after irradiation and changes in leukocyte content of the blood were tabulated; no hematological data are available for animals exposed to 50 kR because the survival span was too short. (TTT)

6873 γ-IRRADIATION INFLUENCE ON BUSHING AND GROWTH OF SIDE SPROUTS OF SOME AGRICULTURAL PLANTS. Savin, V. N.; Shutov, A. A. (Agricultural-Physics Inst., Leningrad). Radiobiologiya, 5: 770-2(1965). (In Russian).

Experiments were carried out to determine the effects of γ radiation on barley, bean, and mint; the first two were exposed as seed, the latter as the plant. Total γ radiation doses up to 20 kR were used, followed by exposure to light, and transplantation of the irradiated specimens into highly fertilized soil. Results with barley and mint indicated that total doses of 3 and 5 kR depress the growth of the main stem and enhance the bushing out of the plant; doses of up to 3 kR caused an increased growth of the lateral branches leading to an improved yield. A study of the influence of the soil on the irradiated plants indicated that in the case of beans, only when highly fertilized soil was used did the exposure inhibit the growth of the main stem and cause increased formation of side branches. It was concluded that it is possible to find a dose level which results in enhanced lateral growth at the expense of the main stem. This fact might be of practical importance. (TTT)

6874 INFLUENCE OF GROWING CONDITIONS ON RADIOSENSITIVITY OF COTTON. Nazirov, N. N. (Inst. of Genetics and Physiology of Plants, Tashkent). Radiobiologiya, 5: 772-4(1965). (In Russian).

The late-ripening, radiation-sensitive S-1622 and the radiation-resistant 1306-DV types of cotton, Gossypium hirsutum L, were studied in order to determine the influence of various factors, such as addition of nitrogen to the soil at various periods during the vegetative cycle, exposure to light, and exposure to various temperatures on the radiosensitivity. The seeds were exposed to a 34 R/sec ^{60}Co source. The results indicated that exposure of the moistened seeds to a dose of 10 kR depresses the growth and reduces the yield of cotton fibers. A larger portion of the S-1622 type plants were killed soon after sprouting than of the 1306-DV type. Introduction of the total yearly requirement of nitrogen before sowing caused a larger number of the plants to perish than fertilizing the plants at 5 days. In the latter case, the growth of the plants was regenerated. A 10-hour day also contributed to the regeneration of the growth processes. Reduction of the intensity of the sunshine caused a reduction of the radiation sensitivity of the plants. (TTT)

6875 THE EFFECT OF IONIZING RAYS OF HIGH ENERGY ON M. TUBERCULOSIS AND VARIOUS ATYPICAL MYCOBACTERIA. A PRELIMINARY STUDY. Benda, R.; Stuhl, L.; Frey, N. (Hopital Beaujon, Paris). Rev. Tuberc. (Paris), 28: 997-1008(1964).

Exposure to a ^{60}Co source produced a marked loss of proliferative capacity of M. tuberculosis in vitro and in the guinea pig. The HRV 37 was distinctly resistant to doses of 30,000 R upwards. Differences between the effect of ionizing rays on the HRV 37 strain and sensitive or resistant strains from untreated patients or patients treated with specific antibiotics were evident. The effects of irradiation on various so-called atypical Mycobacteria supported the theory that there are gradual transitions between the strains and between atypical Mycobacteria and M. tuberculosis. The tendency is too great to exclude certain clinical manifestations from the picture of tuberculosis under the sole pretext that they are not characterized by the presence of authentic M. tuberculosis. This leads to masking of tuberculin reactions. (TCO)

6876 EFFECT OF LOW DOSES OF GAMMA RADIATION ON SOME SPECIES OF CULTIVATED PLANTS. Ostrowska, Apolonia (Inst. of Plant Cultivation, Fertilization, and Soil Science, Pulawy, Poland). Rocz. Nauk Rolniczych, Ser. A, 89: 77-99(1964). (In Polish).

A study of the effect of ^{60}Co γ radiation on yields of wheat, oats, barley, maize, mustard, and lupine was carried out over a period of 3 years. Air-dried seeds or seeds soaked in water for 24 hr were irradiated with doses of 5, 10, 25, 50, 100, 250, 500, 750, 1000, 3000, 5000, and 8000 R. The effect of the irradiation doses on cereal seeds was examined at different stages of growth (at full development of the first true leaf, spreading, full maturity) and on mustard and lupine during the flowering stage. The height of plants, degree of spreading, and foliage yield were determined. In the case of lupine, foliage yield and nitrogen uptake were determined. The results indicated that irradiation of dry as well as water-soaked cereal seeds before sowing with doses up to 1000 R did not affect growth of plants or yield at any of the stages investigated. Wheat was the one exception; in two experiments (out of 9) a dose of 500 R slightly increased the yield. A dose of 5000 R affected dry seeds deleteriously and on wet seeds it was lethal in some instances. Irradiation of lupine seeds did not affect either the yield or nitrogen uptake. Experiments with wheat and maize carried out with different levels of fertilization (high, medium, low), soil water (40, 60, 80%), and various intensities light indicated that the reaction of plants to irradiation does not depend on these factors. (BBB)

6877 INFLUENCE OF X RAYS ON THE DEVELOPMENT OF CELL STRAINS DERIVED FROM LYMPHOCYTES CULTURED IN THE PRESENCE OF PHYTOHEMAGGLUTININ. Astaldi, G.; Costa, G. (Ospedale Civile, Tortona, Italy). Schweiz. Med. Wochschr., 95: 1505-6(Oct. 30, 1965). (In French).

The proliferative activity of lymphocytes stimulated in vitro by phytohemagglutinin is radiosensitive but less so than that of other types of hematopoietic cells. Studies were conducted on the interference by x radiation of the transformation of human peripheral lymphocytes in the presence of this substance. Different batches of peripheral blood lymphocytes were cultivated with phytohemagglutinin immediately after x irradiation at the following doses: 0, 25, 50, 75, 100, 200 300, 400, and 500 R. The percentage of undifferentiated proliferating cells obtained after 3-day tissue culture was 70% for the non-irradiated (control) batch, whereas it was 7% for the batch irradiated with 500 R. Intermediate x-ray doses gave intermediate results. The inhibition of stem-cell development by irradiation may be due to inhibition of DNA and RNA synthesis. It is known that phyotohemagglutinin stimulates the synthesis of DNA and RNA in cultured lymphocytes, which is necessary for their further development. Ionizing radiation is thus able to block this development. (BBB)

6878 INVESTIGATIONS ON COMBINED INJURIES. PART 3. ON THE EFFICIENCY OF RADIOPROTECTIVE SUBSTANCES FOR A COMBINATION OF RADIATION BURDEN AND SKIN WOUND. Langendorff, Hanns; Melching, Hans-Joachim; Messerschmidt, Otfried; Streffer, Christian (Univ., Freiburg i. B.). Strahlentherapie, 2: 264-72(Oct, 1965). (In German).

A combination of total-body x irradiation with an open skin wound considerably increased the mortality of white mice 2 days after irradiation. The radioprotective substance serotonin increased the mortality caused by the skin wound. No protective effect was obtained by administration of serotonin in the combination experiment. Histamine, the biogenic amine, decreased the radiation induced mortality, but increased the mortality caused by the skin wound. In a combination experiment, significant protection was obtained with this amine. There was a significant increase in the survival rate by administration of the sulfhydryl substances cysteine or cysteamine in the combination experiment. Cysteine had no influence upon the mortality caused by a skin wound; cysteamine, however, increased the mortality in mice. (tr-auth)

6879 REACTION OF THE LIVER TO FOCUSED IRRADIATION. Birzle, Hermann; Fliegel, Christian (Univ., Freiburg i. B.). Strahlentherapie, 2: 273-82(Oct. 1965). (In German).

The phenomenon of radiation sensitivity is discussed. The following results were obtained after x irradiating the liver of 22 rabbits with a single dose: inhibition of the protein synthesis above 2000 to 2500 R; increase in serum enzyme activities of GOT, GPT, and SDH above 4000 R; and increase in serum bilirubin levels above 10,000 R. The threshold dose as determined by the bromthalein test was about 500 R; 5000 to 10,000 R are required for an irreversible damage. (tr-auth)

6880 ON THE DETERMINATION OF A LOWER THRESHOLD DOSE FOR FRACTIONATED IRRADIATION OF MICE. Langendorff, Margarethe (Univ., Freiburg i. B.). Strahlentherapie, 2: 302-8(Oct. 1965). (In German).

Mature female mice received fractionated x irradiation with 1 or 2 R/day over 20 days. Observations showed that daily irradiation with 1 R is not sufficient to produce an effect upon the frequency and size of the litter in the irradiated animals. Daily irradiation with 2 R over a period of 20 days reduced the frequency of the litter by 20% when compared with observations made with control animals. The mean size of the litter per animal was unchanged by the irradiations. It was concluded that by using the fertility test in mice, the lower limitation of detectability of radiation influence is between 1 and 2 R/day with short-time fractionated irradiation administering a total dose of not more than 40 R. (tr-auth)

6881 RADIOBIOLOGICAL INVESTIGATIONS ON CHICKEN EMBRYOS. PART I. ON A "3 1/2-DAY EFFECT" ON 2-DAY-OLD EMBRYOS. Helfer, Hannelore; Albers, Henry (Univ., Mainz). Strahlentherapie, 2: 309-23(Oct. 1965). (In German).

Chicken embryos, incubated at 38°C (stage 11, Hamburger and Hamilton), were x irradiated when 2 days old in perforated eggs. A dose independent mean survival time of 3.2 days was obtained for doses between 800 and 2400 R. An additional dose dependent retardation in the morphological development and a reduced growth rate were observed. The $3\frac{1}{2}$ day effect was observed only in the early developing stages of chicken embryos (up to stage 13). A simple method for perforating the eggs is described. (tr-auth)

6882 STUDIES OF THE IRRADIATION EFFECTS ON CELLS. IV. ON THE EARLY CYTOLOGICAL CHANGES OF TUMOR CELLS AFTER IRRADIATION. Kawano, Yoshihiro (Tokushima Univ., Japan). Tokushima J. Expt. Med., 11: 1-13(May 1964).

Morphologic changes of cytoplasmic organelles of ascites tumor cells (MTK-III) after irradiation are described. Whole-body irradiation was given tumor-bearing rats on the 4th day after the transfer of MTK-III tumor cells, and ascites tumor cells were fixed for phase-contrast microscopic examination. X-ray (250 kv) doses of 200 and 500 R were used, and observations were made at 5, 10, 15, 20, 30, 45, 60, 120, and 180 minutes following irradiation. Damage to nuclear membranes, nucleoli and chromatin networks were noted in fixed cells and hanging drop preparations. The irradiation effect suggested some physicochemical change, such as the condensation of cytoplasmic contents. In additional tissue culture experiments, the nuclear membranes of the HeLa cells appeared clear and the nucleoli became distinctly outlined in the early irradiation phase. Granules in cytoplasm were observed to become gradually more refractile. The number of MTK sarcoma III tumor cells which took up azur granules decreased immediately after irradiation and then they recovered during 60 min after exposure. The decrease of cells with azur granules was more rapid than the decrease of mitotic division after irradiation. (TCO)

6883 LIMITED DURATION OF IMMUNOLOGICAL TOLERANCE AFTER CELL TRANSFER. van Bekkum, D. W.; Holt-Moor, L. E. J.; Balner, H. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Transplantation, 3: 448-51(May 1965).

Following the transfer of tolerant CBA cells from CBA → (CBA X C57BL)F_1 radiation chimeras to irradiated CBA mice, a minority of the recipients retain C57BL skin grafts for long periods of time, provided that large numbers of lymphatic cells or very large numbers of bone marrow cells are transferred. Thus, four mice retained their skin grafts for one year or more, with only impaired hairgrowth as macroscopic evidence of anti-graft reactivity. Microscopic examination showed weak but significant signs of a host reaction and the graft vs host (GvH) assay was positive, though not maximal. The results show that even in those animals which appear to remain highly tolerant according to the condition of their skin graft, the spleen cells have regained, at least partly, the capacity to react against C57BL antigens. These results show that even in the CBA parent → hybrid → parent transfer series most animals had lost acquired immunological tolerance after about 100 days. Furthermore, sensitivity of the GvH assay was found to be at least equal to the sensitivity of microscopic examination of skin grafts. It is stressed that the temporary persistence of tolerance in the CBA transfer line, following injection of large numbers of lymphoid cells, is different from the results obtained in the C57BL → F_1 → C57BL line, where tolerance of C57BL cells to CBA antigens was soon lost after transfer to the C57BL hosts, as judged by both skin grafting and the GvH assay. (BBB)

6884 A RADIOBIOLOGICAL STUDY OF THE DEVELOPMENT OF NEWCASTLE DISEASE VIRUS. Kirvaitis, Joanna; Simon, Edward H. (Purdue Univ., Lafayette, Ind.). Virology, 26: 245-53(Aug. 1965).

The Luria-Latarjet type experiment (irradiation of a virus-cell system at various times after infection) was performed on Newcastle disease virus-chick embryo cell complexes. It was shown that the resistance of the infective centers to uv light increases with time after infection. The inactivation curves remained exponential at all times, and maximum resistance was reached 4.5 hr after infection. This is probably a function of the virus rather than the host cell since similar results were obtained when human cells (strain HeLa) were used. An experiment designed to reduce the handling and subsequent trauma of infected cells to a minimum also gave results identical to the standard experiments. The results show that uv inactivates infective centers by interfering directly with virus synthesis rather than by generally upsetting cell metabolic processes. Furthermore, since multiply infected cells are not inherently more resistant than singly infected ones, the presence of more than one genome per se is not a sufficient explanation for the observed results. Multihit inactivation curves were obtained after multiple infection of monolayer cultures. Evidence is presented that multiplicity reactivation of the virus occurs in chick embryo cells infected with virus which had been clumped following irradiation. It is suggested that multiplicity reactivation is the mechanism of the resistance phenomenon. (BBB)

6885 THE TUMOR INDUCING ACTION (BLASTOMOGENESIS) OF HIGH ENERGY PROTONS. Streltsova, V. N.; Moskalev, Yu. I.; Petrovich, I. K. Vop. Onkol., 10: No. 9, 74-7(1964). (In Russian).

Carcinogenesis induced by high energy protons from a synchrocyclotron was studied in rats using proton energies of 120 and 500 Mev. Tumor incidence was higher in females than in males. Occurrence of mammary gland tumors was dose-dependent and energy-dependent. At 500 Mev, doses of 120, 250, 320, 438, and 740 rad induced mammary gland tumors within 12 months in 5, 3, 24, 26, and 50% of the animals, respectively. With 120 Mev protons, incidence of the same tumor was higher. Minimum carcinogenic doses were determined for leukemia and tumors of pancreas, testes, and mammary glands. (H.G.D.)

6886 IMMUNIZATION AGAINST GRAFTS OF ALLOGENIC HEMATOPOIETIC CELLS BY PRIOR BLOOD TRANSFUSION. da Costa, H.; Amiel, J. L.; Mathe, G.

(Hopital Saint-Louis, Paris). Vox Sang., 9: 420-30 (1964). (In French).

It was observed that human bone marrow transplants fail more often in subjects that have received a previous blood transfusion than in those who have not. This finding was explored by experiments in mice given blood transfusions before whole-body irradiation, to condition them for hematopoietic grafts. The effect of prior transfusions of fresh and stored blood was studied in F_1 (DBA/2 × C57B1) mice after ten transfusions (0.1 ml blood) each from F_1 (CBA × C57Br) donors. Fifteen days after the last transfusion they received 950 rad of 200-kv x rays, then, immediately, an infusion of 2×10^7 bone marrow cells from the same donors. The results showed that mice that have received fresh or preserved blood, and later given a lethal irradiation dose, cannot be protected against this irradiation by transfusion of allogenic bone marrow cells from animals belonging to the same strain as the blood donors. Transfusion of red cells was just as harmful in this respect as transfusion of lymphoid cells or skin grafting. Tolerance to allogenic skin grafts, on the other hand, was not shortened by previous blood transfusion. This effect of blood transfusion thus applies only to hematopoietic cells and sets them apart, as regards allogenic grafting, from other tissues and organs. The results support the observations in man that previous blood transfusions compromise the effectiveness of whole-body irradiation in suppressing the homograft reaction. (BBB)

6887 EPIDEMIOLOGIC METHODS IN CANCER RESEARCH. MacMahon, Brian (Harvard School of Public Health, Boston). Yale J. Biol. Med., 37: 508-22 (June 1965).

Some problems encountered in attempts to trace the etiology of cancer are discussed with emphasis on retrospective surveys. Several programs tracing ionizing radiation as an etiologic agent are discussed. Problems encountered in studying leukemia incidence in children x rayed prenatally are discussed. (TCO)

6888 KILLING AND MUTAGENIC EFFECTS OF UV RADIATION ON SPORES OF TRICHOPHYTON TERRESTRE DURIE ET FREY 1957. Lenhart, Karel (Medical Faculty, Olomouc, Czech.). Z. Allgem. Mikrobiol., 5: 222-7(1965).

The lethal and mutagenic effects of uv radiation were studied in the spores of three strains of Trichophyton terrestre of different geographical origin: strain 212 was isolated in Czechoslovakia, strain SZ in Hungary, and strain 2077 in Australia. The killing effect of uv irradiation was marked in all three strains. The dependence of the number of surviving spores on periods of irradiation from 5 to 90 sec at 51.2 mw/cm^2 was exponential. After an irradiation of 5 sec, only 56.1% of the spores of strain SZ survived and of strain 2077 still less, 17.2%. After 50 sec, more than 99% of the spores in all 3 strains have been killed. The curve showing the dependence of the number (%) of survival (log scale) after a given time of uv irradiation (linear scale) could be considered as straight line by applying the method of least squares. The dependence may therefore be considered as exponential. The lethal effect of uv radiation is equally marked in all three strains, but there was some difference in the number of surviving spores in the separate strains with the same irradiation time. Thus, in strain 212, only 10.1% of spores survived irradiation of 20 sec, in strain SZ 21.5%, and in strain 2077 only 3.5%. After 30 sec there were 6.8% surviving spores in strain 212, 3.5% in strain SZ, and only 0.7% in strain 2077. It is evident that the spores of the three strains of T. terrestre differ in their sensitivity to uv radiation. The germination of the surviving spores was retarded in comparison with the controls and the colonies which they formed were characterized by a striking variability in morphology and growth rate. The number of aberrant colonies increased exponentially up to an irradiation time of about 40 sec. In all three strains the number of aberrant colonies surpassed 20% of all colonies formed from spores which had been irradiated for the longest period (90 sec). Of the 241 morphologically aberrant colonies isolated from the irradiated spores, 141 isolates of morphological mutants were permanent after 6 transfers. (BBB)

6889 THE FLUCTUATION OF URINE ELECTROLYTE EXCRETION AND ITS RELATION TO MORTALITY OF MULTIPLE IRRADIATED MICE. Pospisil, M.; Sikulova, J.; Sevcik, F. (Inst. of Biophysics, Brno). Z. Ges. Exp. Med., 139: 112-21(1965).

Individual differences in radiosensitivity of irradiated mice were compared with the changes in the Na/K ratio of the urine, and the prognostic possibilities considered. Male mice, of the H strain, 3 months old, received 6 exposures of 200 R of total-body x irradiation at weekly intervals (total exposure 1200 R). The 180-kv x rays were given at a dose rate of 60 R/min. Five animals died before the exposure time ended. Out of a total of 95 animals, 48 (50.5%) died within 60 days following the last exposure. The changes in the Na/K ratio were followed on 24-hr samples of urine repeatedly taken at 7-day intervals during the irradiation period. The fluctuation of the Na/K ratio in the course of experiments on the individual animals was analyzed by using principles of time series statistics. Three characteristics were chosen, i.e., regularity of fluctuation, mean amplitude, and level of fluctuation of the Na/K ratio. It was shown that low and high amplitudes of fluctuation, accompanied by fluctuation about low and high levels and the least regular type of fluctuation, constitute, from the viewpoint of radiosensitivity of the experimental animals, an unfavorable prognostic sign. The importance of these findings to problems relating to differing individual sensitivity to radiation is discussed. Statistical methods used in evaluating the results are explained. (BBB)

6890 COMPARATIVE CHROMOSOMAL STUDIES OF CANCER CELLS AND BLOOD AND BONE MARROW CELLS IRRADIATED IN VITRO. de Grouchy, Jean (Hopital des Enfants Malades, Paris). Z. Menschl. Vererb.-Konstitutionslehre, 37: 410-25(June 22, 1964). (In German).

Chromosomal aberrations have been reported in neoplastic cells. These are more or less specific in nature. Analysis of chromosomes from a vegetative ovarian cyst, an ovarian carcinoma, and a mammary adenocarcinoma revealed an abnormal, acrocentric chromosome, indicated as K1. This was found in 30% of the ovarian carcinoma cells. An abnormal subtelocentric chromosome indicated as K2, was found in all of the mammary carcinoma cells. Of the two types of cells found, one was paradiploid with 45, 48, and 40 chromosomes, found in each of the tumors. The other was hypotetraploid with 88 to 90 and 52 to 62 chromosomes and which was found only in the ovarian carcinomas. When bone marrow cells and leucocytes from persons with normal karyotypes were irradiated with doses of 100 to 300 R immediately after removal, chromosomal analysis after 3 to 4 days culture showed fewer chromosomal changes in the marrow cells than in the leucocytes. The respective frequencies of changes were 23.8 and 27.6% for 100 R and 71.2 and 79.9 for 300 R. The aberrations consisted of polyploidy, chromosome breaks, and formation of dicentric and ring chromosomes, or of type K1 and K2 chromosomes. One explanation of these results may be that the chromosomal anomalies may be epiphenomena of carcinogenesis. Chromosomal aberrations also could result generally from carcinogenic factors themselves. (BBB)

6891 ON CRANIO-FACIAL DYSPLASIAS AND DERANGEMENTS. Ritter, W. (Univ. Muenster, Ger.). Proc. Int. Congr. Human Genet., 2nd, Rome 1961, 1389-94 (1962). (In German).

The offspring of mice x irradiated with 130 R on the sixth to tenth day of pregnancy at a dose rate of 60 R/min exhibited several types of cranio-facial dysplasias and dental impairments. For the upper jaw these included circumscribed hypoplasia, partial and total fissure formation, and median fusions. In the lower jaw the injuries that appeared were circumscribed hypoplasia, median fusions,

and distal upper and lower jaw fusions. Sometimes the injuries occurred singly, but more often they appeared in combination with one another. The most frequent injury observed was symmetrical or asymmetrical reduction of the entire upper jaw mass. This was accompanied by different degree of unilateral or bilateral microphthalmia. In general, the lower jaw was less sensitive to injury by the x irradiation used than was the upper jaw. The findings showed that there was some relation between occurrence of cranio-facial dysplasias and typical derangements of dental development. (BBB)

6892 CHEMOTHERAPY AND EMBRYOPATHY. Degenhardt, K. H. (Univ., Frankfurt am. Main). pp 1727-9 of Proc. Third Intern. Congr. Chemotherapy, July 22-7, 1963. Stuttgart, Georg Thieme, Verlag, 1964. (In German).

The teratogenic effects of ionizing radiation, thalidomide, and other agents in mouse and hamster embryos are briefly reported. (BBB)

6893 STUDIES ON THE INDUCTIVE PHASE OF ANTIBODY FORMATION: EFFECTS OF CORTICOSTEROIDS AND LYMPHOID CELLS. Berglund, K. (Univ. of Lund). pp 405-17 of Molecular and Cellular Basis of Antibody Formation. Proceedings of a Symposium held in Prague, June 1-5, 1964.

The effect of 17-hydroxycorticosteroids and x radiation on the primary hemolysin response and on lymphoid tissue of mice and rats was studied. Four-hr prednisolone treatment of mice reduced the antibody response to sheep red cells when the administration of steroid was begun within a few hours before and after 10 hr before antigen injection. The time after initiation of prednisolone treatment when the damage to the immunogenic tissue is first manifest is less than 16 hr. The normal function of the immunogenic tissue is restored much more rapidly after the four-hour prednisolone treatment than after x irradiation. Cell-count studies of peritoneal fluid and mediastinal lymph nodes of rats suggested that the functional recovery of the immunogenic tissue after prednisolone treatment is not mediated by increased proliferation of cells in response to the antigen. (BBB)

6894 EFFECTS OF IRRADIATION OF THE EXTERIORIZED RAT KIDNEY [Thesis]. Sloan, Kenneth Wayne. Fort Collins, Colo., Colorado State Univ., 1964. 181p.

Male Sprague-Dawley rats were given single x-ray exposures to a unilaterally exteriorized kidney with the rest of the body shielded. Rats were sacrificed at monthly intervals. Single acute exposures at two levels (500 and 1500 rad) were used to investigate the dependence of the development of morphological alterations on the absorbed dose of radiation. Proliferation and swelling of endothelial cells of arterioles and capillaries appeared to be the essential alteration in the pathogenesis of the radiation-induced nephrosclerosis. Additional degenerative and fibrotic changes in the medial layer of arterioles led to a thickening of the walls and narrowing of the lumina of these vessels. The progressive reduction in vessel caliber produced an ischemic condition in dependent tissues and secondary alterations of glomeruli, parenchymal cells, and the interstitium occurred. A shrunken, fibrotic kidney was the final result of this progressive arteriolonephrosclerosis. The morphological observations observed were directly related to the absorbed dose and inversely related to age at the time of exposure. Arteriolonephrosclerotic changes progressed to extreme levels in adolescent rats of the high dose group but were only moderately severe in adolescent rats which received 500 rad. Mild to moderate kidney alterations were observed in adult rats of the 1,500 rad group while the lower dose produced only minimal changes in adult rats. Persistent systolic blood pressure elevation occurred only in the adolescent 1,500 rad group. Transitory increases in blood pressure occurred in the early part of the series in several control and irradiated rats of both dose groups. Alterations in non-irradiated kidneys were generally similar to but much less severe than those exhibited by the contralateral irradiated kidneys. (Dissertation Abstr.)

6895 A COMPARATIVE EVALUATION OF PATHOLOGIC OBSERVATIONS IN 4-, 7-, AND 10-DAY CHICK EMBRYOS FOLLOWING X-IRRADIATION [Thesis]. Clapp, Neal Keith. Boulder, Colo, Univ. of Colorado, 1964. 182p.

The LD_{50}/24 hours following x irradiation was established for the chick embryo for ages from day two through day 19. Day two was a time of relative radioresistance (1650 rads) while the LD_{50}/24 hours for the remainder of the incubation period varied about a mean of 826 rads. Embryos between the ages of seven to 10 days and between the ages of 14 to 18 days showed an increased radiosensitivity. These periods of increased radiosensitivity were attributed to the onset of function in the liver and in the mesonephros for the first period and to the preparation of the embryo for hatching in the latter. Fatalities that occurred shortly after irradiation in each of the age groups—4-, 7-, and 10-day—were attributed to hemorrhage and vascular collapse. Later deaths were considered to result from a probable fluid imbalance that resulted in accumulations of subcutaneous edema. Both 4- and 7-day irradiated embryos showed severe edema at the same approximate stage of development and greatly exceeded the control weights. This observation was independent of age at the time of irradiation. The liver and mesonephros of the chick embryo were radiosensitive, but recoveries from the insult of ionizing radiation were possible. The mesonephros was suggested as a possible "critical" organ for the chick embryo, especially as related to the edema syndrome. The mesonephros appeared to be more radiosensitive than the metanephros. The nucleoli from irradiated livers and kidneys were larger and more prominent than in non-irradiated controls. This criteria may be an aid in determining if a tissue has been irradiated. (Dissertation Abstr.)

6896 EFFECTS OF EXTERNAL IRRADIATION ON MINERAL METABOLISM IN THE BONES OF ADULT DOGS [Thesis]. Finston, Roland Alan. Ithaca, N. Y., Cornell Univ., 1965. 137p.

One fore leg and one hind leg of each of five adult beagle dogs were given doses from 870 to 2980 rads with 15-Mev electrons generated by a betatron. Fifteen to 86 days prior to irradiation, each dog was given an intravenous tracer injection of Sr-85 (4 to 15 μC/kg). Differences in the post-irradiation retention of Sr-85 between experimental and contralateral control bone could be attributed almost exclusively to damage of catabolic processes responsible for the removal of previously deposited mineral. At intervals between 1 and 448 days after irradiation, the dogs were injected with about 50 μC of Ca-47. The relative retention of Ca-47 in experimental and control legs at 2 to 5 days after injection was considered to be indicative of the relative rates of anabolism (the gain of mineral) in the underlying bones. A collimated scintillation detector was used to assay radioactivity of both isotopes in discrete regions of the legs, in vivo. Strontium-85 incorporated prior to irradiation was lost more slowly from the ends of bones that had received 2000 rads or more than from their contralateral controls, the maximum difference being 25%. Specific activities in post-mortem bone samples corroborated the in vivo observations of the ends, but revealed that minor catabolic damage had occurred in shafts given 2000 rads or more, as well. The retention of Ca-47 injected after irradiation was usually less in the irradiated bones than in their controls, the maximum depression being 23% eight months after 2700 rads. A comparison between the integrated anabolic depression and the catabolic depression revealed that the balance between these two processes could be shifted either toward mineralization or demineralization, depending on which process was more damaged. This, in turn, varied with dose, type of bone, and time since irradiation. (A.G.W.)

6897 GENETIC EFFECTS OF RECURRENT IRRADIATION IN DIPLOID, TETRAPLOID, AND HEXAPLOID TRITICUM SPECIES [Thesis]. Kao, Fa-ten. Minneapolis, Univ. of Minnesota, 1964. 88p.

Dormant seeds of the tetraploid (T. durum) and hexaploid (T. aestivum) species of Triticum were x-irradiated for five

consecutive generations, and the diploid species (T. monococcum) for two generations. Two dosages of x rays were employed for each species. The specific characters studied were mostly chlorophyll mutations that are known to be predominantly recessive. Following the first cycle of irradiation, there was a sharp decrease in mutation frequency as the ploidy increased. After the second cycle, the number of mutations detected was greatly increased in the tetraploid, although no increase was found in the diploid. Subsequent irradiation treatments of the tetraploid did not result in an increase in the mutation frequency. In the hexaploid, chlorophyll mutants were not detected in a significant frequency until after the third cycle of irradiation. Segregation data obtained in the F_2, F_3, and X_3 generations of a number of mutant lines in the tetraploid and hexaploid species suggest that recurrent irradiation is an effective means of inducing mutations of duplicate genes. These data also suggest that, during the evolution of the species, diploidization occurred through spontaneous mutation. The kinds of mutations detected were generally comparable for all three species except that the yellow mutant class, which was found relatively frequently in the diploid, was not observed in the tetraploid and hexaploid. In all three species, the albino mutant class constituted approximately 50% of the total mutants observed, and the classes combining light green and yellow green mutants constituted about 25%. Cytological analyses of the tetraploid and hexaploid species revealed that selection, based on spike fertility, against the build-up of reciprocal translocations in the populations was ineffective and the incidence of chromosomal interchanges increased as the number of cycles of irradiation increased. Based on theoretical considerations, a general formula was derived for self-fertilizing polyploid species to express the probability of detecting mutations as a function of irradiation cycle. (Dissertation Abstr.)

6898 X-RAY DAMAGE AS MEASURED BY DOMINANT LETHALS, SEX-LINKED RECESSIVE LETHALS AND TRANSLOCATIONS IN DROSOPHILA MELANOGASTER AND OXYGEN AND ARGON AS ITS MODIFYING FACTORS [Thesis]. Elequin, Flora Tengonciang. Austin, Tex., Univ. of Texas, 1965. 93p.

Drosophila melanogaster (Oregon-R strain) males, 17-24 hours old, were x irradiated with two fractions of 500 R each, separated by an interval of 20 minutes. The two x-ray fractions in any given experiment were given in the same gas, either oxygen or argon. During the interval between the two x-ray fractions, the flies were kept either in oxygen or in argon. Within one hour after the x-ray treatments each male was mated simultaneously to virgin females for the measurement of induced sex-linked recessive lethals, translocations, and dominant lethals. Each male was remated to the same number (and kinds) of virgin females every two days. Seven such mating periods were allowed before the males were discarded. When the flies were x irradiated in oxygen and kept in argon between the two x-ray fractions, an increase in the damage as measured by sex-linked recessive lethals, dominant lethals, and translocations was observed in the spermatid stage over that observed when the flies were x irradiated in oxygen but kept in oxygen between the two x-ray fractions. With the x rays given in argon, no significant difference was found in the induced sex-linked lethals and translocations between the argon and oxygen treatments during the interval between fractions. For the dominant lethal tests, the results were the opposite those expected; possible reasons are discussed. For the flies x irradiated in oxygen, the peak sensitivities occurred at the early spermatid and meiotic stages. Of the total translocations recovered, the Y-chromosome was involved in less than half and showed no preference for either one of the two major autosomes (2 and 3). The frequency of the translocations involving chromosomes 2 and 3 is 2.6 times as great as the Y-A (autosome) translocations. Chromosomes 2 and 3 were about equally affected by the x-ray treatment. In the F_1 matings, a greater amount of sterility was observed in the translocation tests for the in-oxygen x-ray treatment than for the in-argon x-ray treatment. The in-argon x-ray treatments had about the same number of sterile matings as the controls. The pattern of sterile F_1 matings for sex-linked lethals is not consistent, indicating that the irradiated genomes behave differently in males and females. (Dissertation Abstr.)

6899 EFFECT OF WHOLE-BODY AND PARTIAL-BODY X-IRRADIATION ON EXTRACTABLE CELLULAR COMPONENTS OF THE LUNG. Moyer, Robert F.; Riley, Richard F. 14p. (CONF-650560-9). ORINS. Gmelin, AED-CONF-65-157-1.

Rats were exposed to whole-body doses of 500, 700, or 1000 rads x radiation or partial body doses of 100 rad to the thorax alone or to the remainder of the body. Lung cells were extracted by a lung-wash technique, counted, stained, and analyzed for percentage of alveolar macrophages, polymorphonuclear leukocytes, small mononuclear cells, macrophage size distribution, and the frequency of binuclear macrophages. The number of extracted cellular components were corrected for differences in lung weights and differences in the fraction of wash fluid injected and that recovered from the lung. Data are presented on sequential changes in cell type and distribution values from 9 to 37 days after irradiation. Possible relations of cell type to immune reactions and the development of bacteremia in irradiated animals are discussed. (C.H.)

6900 THE LETHAL EFFECTS OF FISSION RADIATIONS AND 250 KVP X-RAYS IN THE CHINCHILLA. Strike, Thomas A.; Seigneur, Leslie J. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). 15p. (CONF-650560-11). ORINS. Gmelin, AED-CONF-65-157-21.

From 13th Annual Meeting of the Radiation Research Society, Philadelphia.

Data are presented from a comparison of the biological effects of fission neutrons and γ radiation from a reactor and 250 kvp x radiation on chinchillas. The results are compared with data on rats. The fission radiations were more lethal for the chinchilla than x radiation. The individual lethal response of the chinchilla to any given radiation dose was more variable than that of other species. The chinchilla appeared to manifest a relative radioresistance to the classically described gastrointestinal modality of radiation death. (C.H.)

6901 THE ADAPTATION OF CYTOGENETIC METHODOLOGY FOR MONITORING BIOLOGIC RADIATION EFFECTS. Wald, Niel; Pan, Sylvia F. (Univ. of Pittsburgh). 9p. (CONF-650616-11). ORINS. Gmelin, AED-CONF-65-153-19.

From Health Physics Society Annual Meeting, Los Angeles.

Results are summarized from a long-term cytogenetic studies of the relationship between radiation and mammalian blood cell chromosomal aberrations, the relationship between such chromosomal aberrations and leukemia, and the feasibility of field utilization of blood cell chromosome studies for the biologic monitoring of large occupationally exposed human populations. Data are included from preliminary studies of chromosome aberrations induced in rats exposed to 10 dose levels up to 2600 rads of mixed γ-neutrons from a reactor and the effects of 300 rads of x or neutron radiation on the induction of leukemia in mice. Techniques for the semiautomatic methodology are described in which blood slides will be scanned by an automatic microscope, dividing cells located and the image transmitted, translated from analog to digital form, and fed into an IBM 7090 computer, which is programmed to count and match pairs of chromosomes. The results are printed out or displayed for photography and permanent filing after clinical evaluation of the significance of the results. It is concluded that this methodology is applicable to the measurement of acute, cumulative, and late effects of radiation exposure. (C.H.)

6902 HEMATOLOGIC INDICATORS OF PROGNOSTIC VALUE FOLLOWING NEUTRON IRRADIATION. Willhoit, D. G.; Pfitzer, E. A.; Wald, N. (Univ. of Pittsburgh). 5p. (CONF-650616-13). ORINS. Gmelin, AED-CONF-65-153-22.

From Health Physics Society Annual Meeting, Los Angeles.

The utility of peripheral blood counts in the diagnosis and prognosis of acute radiation injury in man is discussed. Data are reported from hematologic studies on rats exposed to mixed fission neutron and γ doses ranging from 22 to 2350 rads. Results indicate that the utility of peripheral blood counts as a biologic indicator prognostic of acute radiation death depends on the mode of death. The lymphocyte counts are of prognostic value to indicate whether or not a significant exposure has occurred, but are not predictive of death if death is associated with intestinal injury. The erythroid series appears to provide a means of predicting death if death is associated with intestinal injury, however, a favorable prognosis concerning intestinal death does not mean that death will not occur due to some subsequent syndrome. (C.H.)

6903 A SURVEY OF BIOCHEMICAL PARAMETERS IN IRRADIATED DOG SURVIVORS. Angel, Charles R.; Woodward, Kent T.; Davis, John; Michaelson, Sol M.; Howland, Joe W. 10p. (CONF-650560-8). ORINS. Gmelin, AED-CONF-65-157-2.

From 13th Annual Meeting of the Radiation Research Society, Philadelphia.

Nineteen biochemical parameters, representing major metabolic areas, were measured in 195 dogs exposed to radiation and 116 unirradiated controls. The animals were exposed to various doses of radiation under a variety of conditions and had survived the exposure for times ranging from 2 to 8 yr. Data are tabulated on the content of urea-N, creatinine, uric acid, bilirubin, cholinesterase, phosphatase, transaminase, Na, K, Ca, Mg, CO_2, chloride, phosphate, and cholesterol in blood serum of irradiated and control animals. (C.H.)

6904 DEMOGRAPHIC FACTORS IN RELATION TO INTERNAL EMITTERS. Weiss, Edward S. (Public Health Service, Washington, D. C.). pp 574-8 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

The possibility is discussed of using basic census data and results of whole-body radiation counting of population samples to establish the biological effects of internally deposited radioisotopes in man. (C.H.)

Radiation Effects Therapy and Countermeasures

Refer also to abstract 6811.

6905 (EUR-2477.f(Vol.1)) ETUDE EXPERIMENTALE DU TRAITEMENT DES RADIOLESIONS PAR LA PADUTINE—DEPOT (KALLICREINE). Rapport Annuel d'Activite du Janvier 10, 1963–Janvier 10, 1964. (Experimental Study of the Treatment of Radiation Injuries by Padutin (Kallicreine). Annual Report, January 10, 1963–January 10, 1964). Mandel, P.; Mantz, J. M.; Gary, C.; Delemen, M.; Michaelidis, P.; Schmitt, C. (Strasbourg Univ. (France)). Mar. 17, 1965. 20p. Dep. mn.

Studies revealed that Padutin has a favorable effect on the treatment of experimental radiodermatitis and radionecrosis in rats and guinea pigs. Also, the mitotic index and collagen determination appear to be valid biological criteria for quantitative appreciation of the cicatrization phenomenon. Comparison of the effects of Padutin with another vasodilating agent such as AET, revealed that the action of Padutin is positive, while AET appears rather to be contra-indicated. However, the biological criteria used (survival tests, determination of the absolute quantity of nucleic acids in a bone system, and cytological studies of this same system) revealed that the action of both Padutin and AET is favorable. This action manifests itself in particular around the seventh day after irradiation. Chromatographic and electrophoretic analysis showed that one single compound is involved, hydrolysis and chromatography of which revealed the presence of all the essential aminoacids, including the sulfurated aminoacids in the proportion of 2%. (P.C.H.)

6906 (EUR-2485.e) THE EFFECT OF VARYING THE ENVIRONMENTAL CALCIUM AND PHOSPHATE CONCENTRATIONS ON NUCLEAR DAMAGE IN X-IRRADIATED CULTURES OF BONE MARROW AND THYMUS. Whitfield, J. F.; Brohee, H.; Youdale, T. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center), May 31, 1965. 9p. Dep. mn.

During the first 6 hrs after irradiation (500 R) of suspension cultures of rat bone marrow, the nuclei of the various blast cells, promyelocytes, myelocytes, normoblasts, and cells of the lymphocyte family lost their reticular nuclear structure and became structurally homogeneous. The rate of post-irradiation development of nuclear homogeneity was increased by lowering the calcium content and raising the inorganic phosphate concentration of the medium. The rate of appearance of nuclear homogeneity in irradiated thymocyte suspensions was affected in the same directions by altering the calcium and phosphate concentrations, but it was less sensitive than bone marrow to variations in the calcium level. The development of nuclear homogeneity in cells from unirradiated bone marrow cultures was unaffected by variation of the calcium content of the medium. (auth)

6907 (EUR-2511.e) BONE MARROW TRANSPLANTATION IN IRRADIATED ANIMALS. PRODUCTION AND APPLICATION OF PATHOGEN FREE ANIMALS IN RADIATION EXPERIMENT. Annual Report, 1964. (Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk). July 15, 1965. 10p. Dep. mn.

Results are given on fetal hemopoietic grafts in monkeys, selective elimination of immunologically active cells in the graft, the pooling of bone marrow from different donors, the modification of secondary disease following foreign bone marrow transplantation, the prevention of secondary disease, the selection of compatible donors, and fundamental work on tissue transplantation. A description of the progress achieved in the field of production and evaluation of pathogen free animals and gnotobionts in radiation research is also included. (auth)

6908 (NYO-2862-1) FRACTIONATION OF THE CELLULAR ELEMENTS OF BONE MARROW AND OTHER HOMATOPOIETIC TISSUES IN AN ATTEMPT TO AVOID HOMOLOGOUS DISEASE AND AID THE ACCEPTANCE OF HOMOLOGOUS TISSUE GRAFTS. Final Report. Stoloff, I. L. (Jefferson Medical Coll., Philadelphia, Pa.). [1965]. Contract AT(30-1)-2862. 20p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The separation of marrow cells into relatively pure cell lines was investigated in order to identify the cell or cells of bone marrow important in protecting against irradiation, infection, and in the production of graft vs host reactions. Several approaches to the separation of marrow cells were attempted. However, the primary goal of separating marrow cells into morphologic and/or functional components was not achieved. The results did show, though, that preparation of cells by density gradient has several things to recommend it. It was found that the minimal dose needed to protect isologous or homologous mice against irradiation is similar for fresh bone marrow and separated marrow. Also, the cells of varying specific gravity found in mouse marrow can be visibly separated in a density gradient. (P.C.H.)

6909 (ORNL-3853, pp 116-17) CHEMICAL PROTECTION AND ENZYME CATALYSIS. (Oak Ridge National Lab., Tenn.).

As a measure of radiation protection to the hematopoietic system, the addition of isogenic bone marrow after irradiation should show little additive effect if the main chemical protection is exerted in the marrow. This question raised the issue of the degree of recovery that can be obtained with marrow alone, as well as the most effective or optimal cell dose for maximum recovery. This was explored by determining the radiation $LD_{50/30}$ for BC3F1 mice, using

various bone marrow cell doses injected intravenously into groups of approximately 100 animals 24 hr after x irradiation. One to two male and female runs were made at each cell dose. The $LD_{50/30}$'s were obtained from a probit analysis of the results made on a Control Data Corporation 1604 computer. No sex difference in recovery was observed at any of the cell doses, so the data were pooled. The response obtained was similar to that seen for drug action in that it was proportional to the logarithm of the cell dose administered. The biphasic nature of the curve is indicative of two separate responses to marrow transfusion, one similar to the radiation sensitivity of the marrow and the other to the sensitivity of the intestine. The first may be interpreted as the rapid and easy restoration of the marrow by relatively small cell doses of the order of 100,000 to 500,000 cells. The second response would seem to be the abscopal effects of a viable marrow on the recovery of the intestine and/or the additional ability of large marrow transfusions to contribute directly to intestinal recovery. Increasing the cell dose by factors of 10 to 100 only served to increase the $LD_{50/30}$ by, at most, 150 R. At high radiation doses, intestinal recovery seems to be a limiting factor. Thus the optimal marrow cell dose for maximum recovery in these mice is 5×10^6 cells. All the animals were kept for 90 days in order to observe any delayed effects, and calculations of an $LD_{50/90}$ are in progress. An analytical study of normal mouse kidney muramidase was investigated using chromatographic techniques. Emphasis was placed on the improvement of methods to minimize the loss of enzyme in the extraction, desalting, and the lyophilization techniques. (C.H.)

6910 THE ROLE OF THE BILE IN THE DEVELOPMENT OF GASTROINTESTINAL SYNDROME IN ACUTE FORM OF RADIATION SICKNESS. Horizontov, P. D.; Fedorovskii, L. L.; Lebedeva, G. A. Arkh. Patol., 27: No. 2, 19-25(1965). (In Russian).

Experiments were carried out on 80 albino rats. A study was made of the role played by bile in the development of the gastrointestinal syndrome in radiation sickness caused by x irradiation of the abdominal area at a dose of 1,000 R. Preliminary evacuation of the bile from the intestine of the irradiated animals prevented radiation diarrhea. Acetylcholine and serotonin reactivity of the isolated intestine changed less in the animals with the bile evacuated from the intestine than in intact irradiated rats. This may be of significance in the mechanism of radiation diarrhea prevention. (Excerpta Med.)

6911 CHARACTERISTICS OF AN ULTRAVIOLET IRRADIATION SENSITIVE STRAIN OF BACILLUS SUBTILIS. Mahler, Inga (Brandeis Univ., Waltham, Mass). Biochem. Biophys. Res. Commun., 21: 384-91(Nov. 22, 1965).

A transformable, ultraviolet sensitive strain of Bacillus subtilis was isolated to examine the dark repair (DR) system in this species and its relationship to the mechanism of transformation with irradiated DNA. Experimental findings indicate that B. subtilis is capable of DR but, contrary to expectation, there is little if any repair of intracellular transforming DNA. Since radiation resistant B. subtilis cells do not show any increased uv sensitivity during their period of competence, the physical state of the intracellular transforming DNA may account for the absence of DR. (auth)

6912 EFFECT OF ANTIBIOTICS ON RADIATION AND PHOTODYNAMIC INJURY OF ERYTHROCYTES. Kriger, Yu. A.; Tambiev, A. Kh.; Zakirov, L. A. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 163: 1274-7 (Aug. 11, 1965). (In Russian).

The possible protective effect of antibiotics on human erythrocytes during radiation and photodynamic hemolysis was studied. These injuries resemble each other in their latent periods, in participation of free radical reactions, and in their successful treatment with antioxidants. Erythrocytes removed from human serum and suspended in a 1% NaCl solution were gamma irradiated with 40 and 80 kR (1000 R/min) doses. After cooling, the erythrocyte suspensions were treated with a 10^{-3} M solution of one of 11 antibiotics considered to be possible inhibitors of hemolysis. Results for both the 40 and 80 kR doses largely coincided, except for oleandomycin. Aureon, streptomycin, isochlortetracycline, aureonamide, and mycerin had protective effects and most of the others were hemolytics. In the phototest the erythrocytes were sensitized with pigment and subjected to light. Aureon, aureonamide, streptomycin, and oleandomycin displayed some protective effects. In another series the radioprotective effect of antibiotics was studied in relation to their effect on the redox potential of the erythrocyte suspension measured with a potentiometer. Aureon, aureonamide, streptomycin, and oleandomycin exerted the highest depressant effect on this potential. Further tests on the optical density of erythrocyte solutions revealed no direct connection between the effect of antibiotics on optical density and their protective effect on erythrocytes. It was concluded that the protective effect of these antibiotics is related to their depressant effect on the redox potential and their neutralization of aqueous and organic peroxides. (ATD)

6913 ADRENAL LOCALIZATION OF A THROMBO-HEMORRHAGIC PHENOMENON. Gabbiani, Giulio; Selye, Hans; Tuchweber, Beatriz (Univ., Montreal). Endocrinology, 77: 177-82(July 1965).

Rats were pretreated with ACTH, 9α-fluorocortisol, or restraint prior to a single intravenous injection of ThO_2-dextrin. Thrombohemorrhagic lesions with necrosis in the adrenals and liver and hyaline glomerular capillary thromboses in the kidneys were induced. The lesions resembled those of the Shwartzman phenomenon. Macroscopic and histologic lesions in adrenals and kidneys are described. The mechanisms through which stress, corticoid, and ACTH exerted their actions were not identified. (H.G.D.)

6914 STIMULATION OF HEMATOPOIESIS BY ANDROGENIC HORMONES. Kennedy, B. J. (Univ. of Minnesota Medical Center, Minneapolis). Geriatrics, 20: 808-15(Oct. 1965).

Clinical studies on the effects of androgens on radio-induced bone marrow hypoplasia are reported. Androgenic hormones were administered to 62 patients with advanced cancer in an attempt to improve the hematopoietic function of the bone marrow. The hormone was given to patients with depressed marrow function associated with tumor or due to previous cytotoxic or irradiation therapy and was also given to some patients in whom cytotoxic or irradiation therapy was to be employed. The androgenic hormones employed were fluoxymesterone, testosterone propionate, or testosterone enanthalate. Stimulation of erythropoiesis was evidenced in 27 of the 62 patients. The major causes for failure to respond were too short a treatment period, inadequate dose of androgenic hormone, iron deficiency, or death due to progressive cancer. (TCO)

6915 DRUGS IN SPACE. Schmidt, Carl F. (Naval Air Development Center, Johnsville, Pa.). J. Amer. Pharm. Ass., NS-5: 361-2(July 1965).

A brief compilation of drugs, including radioprotective agents, useful in ameliorating stress reactions in astronauts is given. (BBB)

6916 POTENTIAL RADIATION PROTECTIVE AGENTS. III. MERCAPTO ANALOGS RELATED TO EPHEDRINE. Bhat, K. V.; McCarthy, W. C. (Univ. of Washington, Seattle). J. Pharm. Sci., 54: 225-8(1965).

Reaction of chlorodeoxypseudoephedrine hydrochloride with sodium thioacetate gave 1-phenyl-1-mercapto-2-(N-methylacetamido) propane. This product was resistant to hydrolysis by aqueous acid or base, but the corresponding disulfide was reduced by lithium aluminum hydride to 1-phenyl-1-mercapto-2-(N-methyl-N-ethylamino) propane. Condensation of chlorodeoxypseudoephedrine hydrochloride with potassium ethyl xanthate gave 3,4-dimethyl-5-phenylthiazolidine-2-thione, which was also resistant to hydrolysis, but was reduced to 1-phenyl-1-mercapto-2-(N,N-dimethylamino) propane. (Excerpta Med.)

6917 RADIATION DOSE RECEIVED BY X-RAY WORKERS IN THE PAST. Kitabatake, Takashi (Aichi Cancer Center Hospital, Nagoya, Japan). Tohoku J. Exp. Med., 86: 148-59(July 25, 1965).

An evaluation was made of radiation doses formerly received by x-ray workers in Japan. Questionnaires, sent to 16 radiologists and 26 senior x-ray technicians engaged in continuous radiation service over 30 years revealed that the radiation dose received after 1954 was diminished to about a half of the dose before 1953, although the x-ray generators and other circumstances remained the same as before. At that time in Japan, the Medical Treatment Law and the Radiation Protection Law were enacted. The effects of using more sensitive film and lead screens on dose reduction are discussed. The overall radiation dose per year received by individual x-ray worker is considered to be 0.31 R at present, compared, with 1.55 R before 1957, 9.3 R before 1953, 90 R before 1945, 240 R before 1940, 350 R before 1935, 520 R before 1930, 680 R before 1926, and 900 R before 1921. (BBB)

6918 SOURCES OF RADIOACTIVE POLLUTION. Eisenbud, Merril (New York Univ. Medical Center, N. Y.). pp 153-74 of Air Pollution. Volume 2. New York, Academic Press, 1962.

A review is presented of atmospheric radioactivity which originates from both natural and artificial sources. This includes a consideration of natural radioactivity of both terrestrial and cosmic origin, and of contamination of the atmosphere by radionuclides from fallout and nuclear reactor effluents. Air sampling and monitoring procedures are also discussed. Attention is also given to the problem of reactor safety in terms of the extent to which atmospheric contamination might occur in the event of a major accident. The potential damage from a major reactor accident is based largely on the assumed behavior of fission products, released as the result of a series of hypothetical mishaps which result in core meltdown, with associated exothermic reactions between reactor materials and the atmosphere. Such a disaster might produce a brief period of contamination of the atmosphere downwind of the reactor. This would be followed by a more extended period of chronic exposure due to the deposition of long-lived fission products. Hypothetical consequences of a major accident are discussed, with a consideration of the manner in which atmospheric debris from a reactor disaster would behave under various conditions of atmospheric stability and precipitation. The potential magnitude of the hazards that could develop in a community in the event of such a disaster justifies, for the time being, the cautious approach which has characterized reactor construction. This cautious approach should continue until experience is gained which will make it possible to eliminate procedures and assumptions that do not add to the safety of a reactor. Nuclear fuel reprocessing plants also present a major potential source of air pollution. Various problems associated with fallout radionuclides produced by detonation of nuclear devices are reviewed, particularly from the point of view of their detection and evaluation of health hazards. (BBB)

6919 DOSE REDUCTION FACTORS (DRF) FOR VARIOUS RADIOPROTECTIVE AGENT IN MICE. Plzak, V. 15p. (CONF-650560-10). ORINS. Gmelin, AED-CONF-65-157-16.

From 13th Annual Meeting of the Radiation Research Society, Philadelphia.

Approximately 2,000 compounds were examined for protective effects in lethally irradiated mice. Although about 400 or 20% of these compounds exhibited radioprotective activity, over a half of these were classified as borderline protectors, that is, as compounds which permit only 10 to 20% of the animals to survive the lethal x ray exposure and another quarter of them were classified as moderate protectors, or agents which permit 20 to 40% of the animals to survive for 30 days. About 100 agents from among those tested in this program, when given to mice prior to a lethal whole-body x ray exposure, will permit 50% or more of the mice to survive. Since it is difficult to compare these agents on the basis of the screening program results alone, additional studies were carried out to determine the dose reduction factor or protective index for 60 of these agents. Over 7,000 adult male CF_1 mice were used for these studies which extended over a period of about two years. Each of the protective agents was tested at four or more radiation dosage levels with at least 30 mice at each level. The drug dose and vehicle were selected on the basis of previous screening results, and each of the compounds was administered intraperitoneally 10 to 15 minutes prior to single 400 or 900 R x-ray exposures. Data are presented on the mortality in both the treated and control groups followed for a period of 30 days. The most effective class of compounds included in this series was the AET derivatives. Detailed results are included for 5 of these compounds. (C.H.)

Radiation Hazards and Protection

See also HEALTH AND SAFETY

Refer also to abstract 7274.

6920 (JPRS-33152, pp 17-38) RADIATION PROTECTION. Translated from pp 294-318, Chapter 10 of Yuan-tzu-neng Ti Yuan-li Ho Ying-yung, July 1965.

Discussion is presented on radiation effects, radiation protection, and radiation monitoring of personnel. Monitoring equipment and methods are described and precaution measures are stressed. (P.C.H.)

6921 THE RISK IN WORK WITH RADIOISOTOPES. Sykora, J.; Kubat, A.; Patocka, S. (SFN, Plzen, Czechoslovakia). Plzensky Lekarsk. Sb., 24: 95-7(1964).

Diagnostic radiation doses that are potentially hazardous to the patient were calculated for various isotopic and radiographic procedures. It was concluded that radioisotope techniques have not appreciably increased the radiation stress to the patient. (H.G.D.)

6922 STRAHLENSCHUTZ IN FORSCHUNG UND PRAXIS. BAND 5. (Radiation Protection in Research and Practice. Volume 5). Freiburg i. B., Verlag Rombach, 1965. 244p.

Scientific and practical questions of radiation protection which are of concern to the individual and to the population are discussed in the 19 papers comprising this volume. Genetic questions of radiation protection, radioinduced deformities, questions of liability and insurance, and the concept of radiation risk during occupational exposure are discussed. (J.S.R.)

6923 QUANTITATIVE MEASUREMENT OF MIXED RADIOISOTOPES IN HUMANS BY GAMMA RAY SPECTROSCOPY: THE MIXED FISSION PRODUCTS $^{140}Ba-^{140}La$, $^{95}Zr-^{95}Nb$ AND $^{103}Ru-^{103m}Rh$. Mehlhorn, Werner; Weiland, Raymond L.; Lagemann, Robert, T.; Meneely, George R. (Vanderbilt Univ., Nashville). pp 122-34 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Problems involved in quantitative measurements of mixed radioisotopes in humans by γ spectroscopy are discussed. A direct method is described in which the spectrum of each known isotope is measured and a standard spectrum is established for a certain size and shape of human body. Each complex spectrum produced by a mixture of isotopes is then only a superposition of the single spectra and can be separated into single spectra by a computer. When the human body cannot be used for calibration because of the small permissible body burden of an isotope, other isotopes with approximately the same energy of γ transition can be used for calibration. Problems presented by the fact that the human body represents an extended source with considerable change in size, the composition of isotope mixtures and relations between parent and daughter isotopes, and changes in Compton background are considered. Calibration factors are presented that are based on units of counts of photopeak area per min for different absorber thicknesses and it is recommended that different calibration factors be used

for different thicknesses of the human body. Results are presented from experiments made to test the method using $^{140}Ba-^{140}La$ in equilibrium, $^{95}Zr-^{95}Nb$ in equilibrium, and $^{103}Ru-^{103}Rh$ in equilibrium. (C.H.)

Radiotherapy and Radiodiagnosis

Refer also to abstract 7458.

6924 (AED-C-10-04) RADIONUCLIDES IN GASTROENTEROLOGY. Series C: Bibliographies. (Freie Universitaet, Berlin (West Germany)). Sept. 1965. 110p. Dep. mn.

Approximately 400 references are given to journals and reports published during 1964 and 1965. An author index is included. (P.C.H.)

6925 (BNL-9671) INFORMATION THEORY APPLICATIONS IN RADIOISOTOPE SCANNING. Robertson, James S. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT(30-2)-Gen-16. 12p. (CONF-651035-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Symposium on Advances in Dynamic Radioactive Scanning, Pittsburgh.

Information theory is based on the premise that a given state of knowledge can be measured. These definitions invariably end up in mathematical formulations, as there have been various attempts to express the idea involved in words. A review of these ideas is presented. Applications of information theory to radioisotope scanning are discussed. (M.O.W.)

6926 (BNL-9726) APPLICATION OF EXTRACORPOREAL IRRADIATION OF THE BLOOD AND LYMPH IN LEUKEMIA AND HOMOTRANSPLANTATION. Schiffer, L. M.; Chanana, A. D.; Cronkite, E. P.; Greenberg, M. L.; Joel, D. D.; Stryckmans, P. A. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT(30-2)-Gen-16. 24p. (CONF-651120-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 15th Hahnemann Symposium, Philadelphia.

The basic principles of two techniques for studying cell proliferation and physiology are discussed, along with the ability of lymphocyte depletion to prolong the acceptance of foreign skin transplants, its potential use in the transplantation of human organs, its initial use in the study of bovine leukemia, and its ultimate application in the treatment of human leukemia. The two methods are extracorporeal irradiation of the blood (ECIB) and direction of thoracic duct lymph through an irradiator (ECIL) or a continuous flow centrifuge. The results showed that ECIB can accomplish a general depletion of the total body lymphocyte mass. However, it was concluded that if almost complete ablation of the lymphocyte is required to prevent homograft rejection other procedures will be necessary. It is postulated that for chronic lymphocytic leukemia ECIB may very well prove to be a good treatment. (P.C.H.)

6927 AN AUTORADIOGRAPHIC STUDY ON TUMOR CELLS. Bastos, A. L.; Nunes, J. F. M.; Terrinha, A. M.; Baptista, A. M. (Portuguese Cancer Inst., Palhava). Acta Cytol., 9: 234-8(May-June 1965).

A study was made of ^{32}P uptake by exfoliated cancer cells, in vivo and in vitro. Autoradiographic techniques were used to relate the degree of labeling with the malignant transformation of the cell. Tissues investigated were: human adenocarcinoma of the breast with pleural invasion, esophageal cancer, Sarcoma 37, and growth explants of Sarcoma 37. Autoradiography was done by the stripping film technique. The results showed that isolated malignant cells have an Exposure Index (heavily labeled nuclei) much lower than that of the normal benign exfoliated cells from esophagus and pleural fluid. Autoradiographs of Sarcoma 37 cells showed results comparable to those of cancer cells of esophagus using the same relative Exposure Index. The observation that not all malignant cells incorporate ^{32}P at a given time was related to the cancer cell cycle. It is concluded that the heavily labeled nuclei of exfoliated cancer cells, as revealed by autoradiography using ^{32}P, can contribute to a better definition of a malignant cell. (TCO)

6928 AN APPRAISAL OF THERAPEUTIC METHODS FOR SKIN CARCINOMA BY SCALPEL OR ELECTRO-SURGERY, IONIZING RADIATIONS, ELECTROCHEMO-SURGERY, AND LOCAL CHEMOTHERAPY. Belsiario, John C. (Royal Prince Alfred Hospital, Sydney). Acta Dermato-Venerol., 44: Suppl. 56, 34p.(1964).

Advantages and disadvantages of x and γ radiation from radium applicators, chemotherapy, and surgery for skin carcinoma are compared, and detailed dose data are given that will ensure, a maximum cancericidal effect while sparing normal tissues and giving good cosmic results in eradication of skin cancer. (TCO)

6929 LATE RESULTS OF TREATMENT OF CERVICAL CARCINOMA WITH ^{60}Co TELETHERAPY AND INTRAUTERINE RADIUM. Nolan, James F. (Los Angeles Tumor Inst.). Amer. J. Obstet. Gynecol., 92: 684-93 (July 1, 1965).

The cure and complication rates were compared for two groups of patients with cervical carcinoma, one treated by conventional x rays and the other by ^{60}Co. The study included 40 patients treated by 450-kv x rays plus radium, and 78 patients treated with ^{60}Co plus radium. Thus, in both groups of patients with Stage II and Stage III carcinoma of the uterine cervix, Ra was used in addition to external irradiation. In general, the ^{60}Co plus Ra series showed superior end results. The occurrence of complications of moderate or major nature were compared. In the Stage III patients after 450-kv x-ray plus radium treatment there were 25 who exhibited no complications attributable to their primary treatment. One patient developed hemorrhagic cystitis and another factitial proctitis. Both of these patients were treated conservatively without surgical interference. In the ^{60}Co plus radium group, 19 showed no moderate or major complications. One patient developed cystitis, and two developed servere proctitis. Both of the latter were subjected to colostomy, one temporary and one permanent. For Stage II patients in the 450-kv x-ray plus radium group there were 56 who showed major complications. Two developed cystitis and 5 factitial proctitis. All were treated conservatively. In the ^{60}Co plus radium series, 51 patients showed no major complications. Two patients developed cystitis and one proctitis, which responded to conservative management. One patient developed severe proctitis, necessitating temporary colostomy. Another individual developed severe late hemorrhagic cystitis, which did not respond to intensive treatment and caused death. (BBB)

6930 TUMORS OF THE LIVER FOLLOWING ADMINISTRATION OF THOROTRAST. Suckow, Earl E.; Henegar, George C.; Baserga, Renato (Veterans Admin. Res. Hospital, Chicago). Amer. J. Pathol., 38: 663-7 (June 1961).

A case of hepatic bile duct carcinoma following Thorotrast administration is reported in detail and a summary is given of the knowledge of tumor incidence and the distribution of Thorotrast in tissues. The possible mechanism of tumor induction is discussed. This 39-yr-old man had been given an unspecified amount of Thorotrast by intravenous injection to establish the diagnosis of liver abscess. Surgical drainage of the liver abscess was carried out, and the patient remained free of symptoms for 15 yr. At autopsy, the center of the liver contained bile duct carcinoma, with extensive necrosis, hemorrhage, and fibrosis. Chemical analysis of liver, spleen, bone, and kidney revealed Thorotrast. (TCO)

6931 THE IMPLANTATION OF LOW INTENSITY RADIUM NEEDLES IN THE SUPRACLAVICULAR AND INTERCOSTAL SPACES. McNeill, Joseph P.; Goode, John V.; Martin, James A. Amer. J. Surg., 110: 717-19(Nov. 1965).

An improved technic of implantation of Ra needles in the thorax for breast cancer is described. The complications of such Ra therapy combined with external irradiation are reported. (TCO)

6932 EVALUATION OF PREOPERATIVE RADIATION OF BRONCHOGENIC CARCINOMA. Greer, Allen E.; Carey, John M.; Zuhdi, Nazih. Amer. J. Surg., 110: 732-6(Nov. 1965).

The value of ^{60}Co γ irradiation of the chest before thoracotomy for lung cancer was studied in 90 cases. Clinical results and complications of radiotherapy are reported. The tumor dose varied between 2000 and 6400 R. (TCO)

6933 THE TREND IN RADIOLOGY IN VETERINARY MEDICINE. Schnelle, Gerry B. (Angell Memorial Animal Hospital, Boston). Amer. J. Vet. Res., 26: Suppl. 532-4(Mar. 1965).

Past and present use of radiodiagnosis by veterinarians is reviewed. Trends in radioprotective practices among veterinarians are discussed. (BBB)

6934 GONADAL DOSE IN THE COURSE OF THORACIC STRATIGRAPHY. Colombini, E.; Schippisi, G. Gagnoni (Univ., Parma, Italy). Ann. Radiol. Diagn., 34: 46-55(Mar. 1961). (In Italian).

The gonad doses were measured in 100 men and 100 women during pulmonary radiography. The apparatus used was a Barazzetti tomograph, equipped with a Baxtronic 500 x-ray tube operated at 55-60 kv and 50-100 ma-sec (focal distance 120 cm, stratigraphic angle 30°). Both Victoreen and Gilardoni dosimeters were used, good correlation being obtained between the measurements. In men the dose was measured at the scrotum and in women on the abdominal skin at the position of the ovaries. The arithmetic mean dose for the testes during radiography of the thorax was 6 mR for eight to nine films, or about 0.7 mR per exposure. In women the ovarian dose was 900 mR for a complete series, or 100 mR for a single exposure. In men, because of the location of the dosimeters, the measured dose was close to the absorbed dose or about 0.7 mrem/film. In women, the absorbed ovarian dose would be less than that measured at the skin, and can be estimated on the basis of previous phantom and intraabdominal dosimetry studies. These results are compared with those obtained by other investigators. (BBB)

6935 HYPERTHYROIDISM: COMPARATIVE RESULTS OF MEDICAL (^{131}I) AND SURGICAL THERAPY. Bowers, Ralph F. (Veterans Administration Hospital, Memphis). Ann. Surg., 162: 478-91(Sept. 1965).

A long-term follow-up study was made on surgically treated and ^{131}I-treated patients. Significant postoperative complications involved parathyroid deficiency in three patients. Nerve injury, infection, and hemorrhage were not significant complications. The ^{131}I therapy proved to be exceedingly satisfactory in the mild hyperthyroid patient with diffuse toxic goiter. After the usual diagnostic studies, 82 patients were treated by ^{131}I, with doses varying from 1 to 16 mC. These small dosages were used to achieve euthyroidism without inducing a deep myxedemic state. No nodular toxic goiter was irradiated in this series. There was no mortality attributable to the ^{131}I, no early complications, and no incidence of late cancer formation in this group. Myxedema, although present in two patients, did not prove to be a problem, mainly, it is believed, because small doses were administered. The number of hospitalizations and hospital days for the surgically treated patient was much lower than for the ^{131}I-treated patient. The average time for achievement of euthyroidism by ^{131}I therapy was 453 days, with a max of 1460 days. Euthyroidism was achieved in the surgically treated patient in 6 weeks. It appeared that once the euthyroid state was established, no recurrences followed ^{131}I therapy. The findings suggest that ^{131}I therapy is superior to operation in the patients with mild hyperthyroidism, recurrent thyrotoxicosis, malignant exophthalmos, and in those patients who do not desire operation or whose associated conditions impose contraindications. Thyrocardiac patients responded more favorably to operation than to ^{131}I therapy. Until results of ^{131}I therapy improve, subtotal thyroidectomy seems superior in the moderate-to-severe, diffuse toxic goiter in young patients who cannot afford the time due to invalidism. Myxedema in patients following irradiation was not a problem in this series but may appear later if cell destruction, finally inducing euthyroidism, is more extensive. (BBB)

6936 PATHOLOGICAL CHANGES IN 37 HUMAN RENAL HOMOTRANSPLANTS TREATED WITH IMMUNOSUPPRESSIVE DRUGS. Porter, K. A.; Marchioro, T. L.; Starzl, T. E. (St. Mary's Hospital, London). Brit. J. Urol., 37: 250-73(June 1965).

Pathological changes in 37 human renal homotransplants are described. All the patients were treated with Imuran, prednisone, and actinomycin C and ten also received local x irradiation to the transplant, each course consisting of three or four doses of 150 R every other day. (TCO)

6937 MORPHOLOGICAL ASPECTS OF RENAL HOMOGRAFT REJECTION. Porter, K. A. (St. Mary's Hospital, London). Brit. Med. Bull., 21: 171-5(May 1965).

Use of ionizing radiation and other immunosuppressive agents in preventing homograft rejection is reviewed. (BBB)

6938 PARTIAL PITUITARY ABLATION WITH IMPLANTS OF ^{198}Au AND ^{90}Y FOR CUSHING'S SYNDROME WITH ASSOCIATED ADRENAL HYPERPLASIA. Hartog, M.; Doyle, F.; Fotherby, K.; Fraser, Russell; Joplin, G. F. (Postgraduate Medical School, London). Brit. Med. J., 2: 392-5(Aug. 14, 1965).

The effectiveness of pituitary implantation of seeds of ^{198}Au or ^{90}Y in 22 patients with Cushing's disease was assessed by measuring changes in adrenal steroid excretion. For the first eight patients the implants were of ^{198}Au planned to deliver 10,000 rad to the periphery of the pituitary. Subsequently, combined implants of ^{198}Au and ^{90}Y were used; the activities of each of which were planned to give 5000 rad to the gland surface. Five patients had repeat implants, with ^{90}Y alone: one had the same dose as in the first implant, three who had pituitary tumors were given doses of 100,000, 50,000, and 50,000 rad at the gland surface; and the fifth, who had very severe disease, received a dose of 100,000 rad to the gland surface. The results of urinary 17-oxogenic steroid measurements during dexamethasone and Metopirone tests before and after operation are described, and their value in demonstrating pituitary-dependence before implantation, and in assessing the remission afterwards, is discussed. Of 14 patients without obvious pituitary tumors the response to the first implant was satisfactory in eight, and there was a partial response in four. Of the six patients with obvious pituitary tumors, four showed a partial response. There was no evidence of hypopituitarism after operation, apart from one patient who developed amenorrhea. Patients who had the combined implants of ^{198}Au and ^{90}Y did no better than the seven who had ^{198}Au alone. The complications that have occurred are described. (BBB)

6939 PARTIAL PITUITARY ABLATION WITH IMPLANTS OF ^{198}Au AND ^{90}Y FOR ACROMEGALY. Hartog, M.; Doyle, F.; Fraser, Russell; Joplin, G. F. (Postgraduate Medical School, London). Brit. Med. J., 2: 396-8 (Aug. 14, 1965).

Techniques, dose consideration, clinical results, and complications are discussed relative to 22 patients with acromegaly treated by radioisotopes to reduce pituitary secretory activity. Since at least 100,000 rad is required to destroy pituitary tissue, it was decided to use a dose giving 10,000 rad to the periphery of the gland. In the initial series grains of the γ-emitting ^{198}Au were used in the hope that the diffuse penetrating irradiation produced by this source would ensure irradiation of all parts of the pituitary without causing excessive necrosis. Later, when it became clear that more irradiation was required, combined implants of ^{198}Au and ^{90}Y were used, giving the same peripheral dose but with half planned to come from each source. Since ^{90}Y emits β rays of high energy, the intense local necrosis would destroy the center of the pituitary, without incurring any greater risk of damage to the surrounding structures, because the peripheral dose was un-

changed. Recently the dose has been increased again, and ^{90}Y alone is being implanted with a planned peripheral dose of 20,000 rad. The response to the treatment was classed as satisfactory in 13, partial in six, and not improved in three. (BBB)

6940 TURNOVER OF LABELLED PLASMA PROTEINS. McFarlane, A. S. (National Inst. for Medical Research, London). Bull. Schweiz. Akad. Med. Wiss., 21: 173-84(1965).

Various problems associated with the use of labeled plasma proteins in metabolic studies are discussed, such as reutilization of labeled amino acids, in vitro and in vivo methods of synthesizing labeled proteins, self-radiation damage, and specific technics with radioiodine-labeled proteins. For practical purposes, in vitro labeling consists almost exclusively of combination with iodine and a second major cause of denaturation is self-radiation damage by the iodine isotopes. This often takes place while radioactive commercial preparations are stored awaiting results of sterility tests before being dispensed. The specific activity below which this kind of damage occurs at an insignificant rate is widely accepted as 5 to 10 μC/mg protein. The proper precautionary procedure to be used to avoid damage is prompt dilution with inactive protein. Proteins labeled with ^{125}I are becoming commercially available and since this isotope has no β radiation these should have a much longer shelf-life than ^{131}I-proteins. With labeled proteins which are to be used for tracer purposes self-radiation damage can generally be avoided but this may not be true of very high specific activity preparations such as are sometimes used for isotope therapy, or for estimating levels of hormone antibodies. Conditions governing protein radioiodination are also considered. Of the numerous factors which affect the quality of iodine-labeled proteins, the most sensitive one is the proportion of iodine incorporated into the molecule. In general, this should not exceed one atom per molecule but in the case of fibrinogen the upper limit is 0.6 atoms. The presence of denatured labeled protein gives rise to falsely exaggerated values for the extravascular pool mass of the protein in a recipient animal. This arises from the fact that removal of denatured molecules from the blood by reticuloendothelial cells for the most part is complete with the first few hours and is indistinguishable from simultaneous loss into the extravascular space. (BBB)

6941 OSTEOGENIC SARCOMA IN CHILDREN. McKenna, Robert J.; Schwinn, Charles P.; Higinbotham, Norman L. Calif. Med., 103: 165-70(Sept. 1965).

Clinical data are reviewed for 130 children less than 16 years of age with pathologically verified osteogenic sarcoma treated during a 30-year period. The use of radiation in the treatment of these tumors is considered. Pathogenesis and the cause of osteogenic sarcoma remain unexplained and in only three cases did the lesion originate in bone altered by preexisting disease or previous treatment. Two children had received radiation therapy, one for a neuroblastoma and the other for a humeral bone cyst, and in both cases an osteogenic sarcoma developed in the treated bone, six years later in one case, eight years in the other. In another case, a secondary chondrosarcoma developed in an osteochondroma. Most (103) children were treated surgically and in all but two cases amputation was carried out. Fifty-four (52.5%) of the surgically treated patients received preoperative irradiation from various sources: Radium packs, orthovoltage x rays, or supervoltage x rays. A tumor dose varying from 1500 to 12,000 rad was complemented by surgical ablation one day to many months after completion of radiation therapy. Nine children were treated solely by radiotherapy. However, irradiation as the sole method of therapy was never curative; preoperative radiation therapy has been advocated by some therapists, but no evidence was found in the present series to support this recommendation. The absolute survival for the entire series of 130 osteogenic sarcomas was 18.5% at five years and 16.2% at 10 years. Survival after irradiation ranged from three months to 26 months after diagnosis with an average and median interval of 12 months. Treatment failures were more frequent in patients receiving preoperative irradiation and amputation than in patients treated solely by amputation. (BBB)

6942 POSSIBILITIES OF REDUCING THE HARMFUL DOSES IN INTRAORAL ROENTGENOGRAPHY. Chvojka, Z.; Novotny, J. (Medical Faculty of Karlovy Univ., Hradec Kralove, Czech.). Cesk. Stomatol., 65: 125-36(Mar. 1965). (In Czech).

Protection practices in use of x-ray equipment in dental clinics are discussed both with respect to reducing dose delivered to patients (in and beyond the useful beam) and to personnel. Extensive photographic and dosimetric data were obtained in the process of measuring the dermal doses, doses of scattered radiation round the x-ray tube, and other doses on the investigated patients during the taking of intraoral roentgenograms without filtration and with an aluminium filter, with a large and small diaphragm, and with different values of ma-sec readings. Tabulated data show measured doses to the mouth, sternum, and gonads for various combinations of kilovoltage (50 and 65 kv), milliamperage (0.5 to 8 ma), filtration (0 or 1 mm Al), and diaphragm apertures (14 and 27 mm). When the results were compared with literature data and analyzed with regard to the present equipment available in radiologic laboratories, and various other possibilities were considered, it was found that the most effective, simple, and least expensive means for the reduction of patient doses in intraoral roentgenograms is the filtration of the useful radiation beam of the x-ray apparatus by the filters (1 mm of Al) and application of a spherical lead diaphragm with the dia of 14 mm. The importance of adjustment of physical factors to give optimal dose-reduction results is discussed. (BBB)

6943 RADIOISOTOPES IN MEDICAL DIAGNOSIS. Fowler, J. F. (Postgraduate Medical School, London). Chem. Ind. (London), No. 31, 1353-5(July 31, 1965).

History of the use of radioisotopes in diagnostic tests is reviewed, new developments in the field are described, and the necessity of selecting radioisotopes and technics that will give the lowest possible exposure to the subjects examined is emphasized. The development of the gamma camera appears likely to revolutionize scanning. A gamma camera contains a single large detecting crystal which is stationary and views the patient through a lead honeycomb 3 in. thick. The sensitivity of the gamma camera is over 10 times greater than conventional scanners, roughly in proportion to the surface area. Scans can now be done in 3 to 5 min, or longer times can be used to give improved statistical accuracy. An important point is that since gamma cameras are stationary, they can utilize isotopes with half-lives so short that a conventional scanner would lose part of its picture by radioactive decay in the time taken to move from one end of its raster to the other. The cameras are not only faster, but they make dynamic studies possible, such as kidney function tests. Radiation safety of the patient is discussed. The total radiation dose given to a patient by any of the procedures described can be kept to a minimum level consistent with obtaining a significant result. In the case of children or young mothers, particular care is taken to use short-lived radioisotopes, for example, 2.3 hr ^{132}I instead of 8-day ^{131}I wherever possible. (BBB)

6944 A SIMULTANEOUS RADIOTESTER, A COMBINED INSTRUMENT FOR ISOTOPE DIAGNOSIS. Belzer, H.; Graul, E. H.; Hundeshagen, H. (Philipps-Univ., Marburg, Ger.). Elektromedizin, 10: No. 1, 1-5(1965).

The simultaneous-radiotest unit developed in the Department for Radiobiology and Isotope Research of the Marburg University is described. It has 9 channels for activity measurements, and one channel each for ECG and time signals, and is used in clinical functional diagnosis with radioisotopes, such as heart circulation measurements and renal function tests. Since pulse height analyzers are built in, two radioactive substances of different energy can be measured simultaneously. Therefore the unit can

also be applied in hemodiagnosis. All information is stored in a 12-channel tape recorder and is thus available for later individual plotting and evaluation. For writing the stored information, several strip-chart recorders are built in the unit; a dual-beam oscilloscope with camera is connected for recording rapidly changing phenomena. (Excerpta Med.)

6945 SENSITIVITY OF THE THYROID TO IRRADIATION AND THE RADIOELECTROPHORETIC PATTERN OF SERUM PROTEINS IN HYPERTHYROIDISM TREATED WITH ^{131}I. Magas, Stanislaw (Academy of Medicine, Poznan, Pol.). Endokrynol. Pol., 16: 27-35(1965). (In Polish).

Attempts were made to correlate the response of the hyperactive thyroid gland to internal irradiation by radioiodine with ^{131}I content of various serum protein fractions. Electrophoretic studies were conducted before and after ^{131}I treatment of 51 patients (43 of them women) ranging in age from 33 to 70 yr with thyrotoxicosis. They were given from one to six doses of radioiodine, totaling 3.5 to 25 mC. Radioelectrophorograms prepared from patients' serum showed three main zones of radioactivity, namely, in the albumin, inter-α-globulin, and β-globulin regions. A table shows the dose of ^{131}I administered and the serum protein ^{131}I distribution in these three zones. Usually about 75% of the total serum radioactivity was present in the inter-α-globulin zone, with little or none in the β-globulins, and the remainder in the albumin. However, in the resistant cases (requiring four to six doses of ^{131}I) a significant portion of the total serum protein radioactivity was present in the β-globulins. It averaged about 20% in this zone compared with <5% in patients who responded to lower doses of ^{131}I. (BBB)

6946 PHYSICAL PROBLEMS OF SPLEEN SCINTIGRAPHY. Wolf, R.; Fischer, J. (Institut fuer Klinische Strahlenkunde, Univ., Mainz, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed., 102: 319-30(Mar. 1965). (In German).

If certain specific conditions are met, the size and shape of the human spleen can be estimated by scintigraphic measurement. The shape of the spleen can be considered to be an ellipsoid whose axes are 2, 4, and 6 cm. If it is assumed that its size increases proportionately in all directions, then the relation between its volume(V) and its planimetric size(F), measured scintigraphically, is $V = aF^{\frac{3}{2}}$. The proportionality factor a has been established from weight measurements of spleens obtained by surgery or autopsy to be 0.3. However, the spleen can still be larger than it seems to be from a measurement of the lateral aspect because sometimes only the section limited to the cosine of the slope angle between the scintigraphic plane and the position of the greatest diameter can be measured. Also, the assumption that the spleen becomes enlarged uniformly is not always true. Finding radioisotope deposition defects in the spleen is also a problem, because the spleen may vary in size much more as compared to other organs. If the spleen size is increased uniformly, small defects of about 2 cm dia are detectable by scintigraphy. The energy of the radioisotope used is also a parameter important to detection of uptake defects. Use of a soft γ emitter such as ^{197}Hg makes the detection of defects on the upper surface of an enlarged spleen easier than if ^{51}Cr is used. (BBB)

6947 RENAL SCINTIGRAPHY IN CHILDHOOD. Frey, K. W.; Heinze, H. G.; Hoer, G. (Univ., Muenchen, Ger). Fortschr. Med., 82: 637-40(Sept. 10, 1964). (In German).

Before any radioisotope is used for renal scintigraphy, consideration should be given to whether other clinical studies are able to give equivalent information. Renal scintigraphy is a relatively nonhazardous procedure to be used in children. Some of the renal symptoms that can be diagnosed by this procedure are the determination of the position of dystropic kidneys, renal malformations, such as hypoplasias and horseshoe kidneys, kidney atrophy, hydronephrosis, cysts, and proliferative tissue changes, such as Wilms tumor, hypernephroma, and benign tumors. Renal scintigraphy is best carried out in the prone position. The velocity of detector movement may range from 16 to 26 cm/min, and the total time required for this study may vary from 30 to 45 min. If a child becomes restless during scintigraphy, light sedation may be used. If ^{131}I-hippuran is used to evaluate kidney function the gonadal dose is about 50 mrad, the kidney dose is about 200 mrad, and the whole-body dose is about 5 mrad. When ^{203}Hg-neohydrin is used for scintigraphy, the gonadal dose is between 10 and 60 mrad, the kidney dose is from 3 to 15 rad, and the whole-body exposure is 3 to 10 mrad. (BBB)

6948 OBSERVATIONS ON THE ACTION OF A NEW DERIVATIVE OF PHENYLBUTAZONE, 1-PHENYL-2-p-HYDROXYPHENYL-3, 5-DIOXY-4-n-BUTYL PYRAZOLIDINE, IN A GROUP OF SUBJECTS SUBJECTED TO TELECOBALT THERAPY. Laconi, A.; Barberi, I. (Univ., Palermo, Italy). Gazz. Med. Sicil., 7: 8-14(1962). (In Italian).

This drug, Tanderil, was tested as a preventative against side-effects of radiotherapy on the basis of its anti-inflammatory, antiedematous, antipyretic, and analgesic effects in experimental animals. It was tested in 40 subjects with neoplastic disease treated by ^{60}Co γ radiation. Oral doses of 100 mg were given four times daily for six to seven days, then maintenance doses of 200 to 300 mg daily for 15 to 20 days. Or, it was given rectally in 2 to 3 250 mg/day. Detailed data are given for each patient, including radiation dose administered, response to the drug, and side-effects from it, if any. No rigorous evaluation of its effectiveness was made, but it is claimed to have been beneficial in most cases. Individual cases are described wherein the drug is said to have alleviated pain and swelling. An antifebrile response was seen in some cases. Edematous changes in oral mucosa caused by radiotherapy were suppressed in several cases. No side-effects of the drug were detected by routine hematologic tests. (BBB)

6949 MULTIPLE HEMANGIOSARCOMAS OF THE LIVER FOLLOWING CEREBRAL ANGIOGRAPHY WITH THOROTRAST. Hohenstatt, H. (Staedtische Krankenanstalten, Heilbronn, Ger.). Hippokrates, 36: 227-8(Mar. 31, 1965). (In German).

A patient, who had received Thorotrast as a contrast medium for cerebral angiography 18 yr prior to death from multiple hemangiosarcomas, had deposits of Thorotrast in the right carotid artery, liver, and spleen. The liver showed multinodular atrophic cirrhosis. There was some evidence of esophageal varices. The patient was slightly icteric before death. In the liver there were multiple hemangiosarcomas located mainly on the surface. In the right lobe a mass the size of a child's head, with hemorrhagic fibrotic areas on its surface, was found. There was evidence of massive hemorrhage into the abdominal space amounting to over 2 l of blood and blood coagulum. There was massive coronary sclerosis and general atherosclerosis. Brain atrophy was prominent, with external and internal hydrocephalus. This case suggested that there was a causal connection between a radioinduced malignant growth resulting from Thorotrast deposition and a fatal intraabdominal hemorrhage. (BBB)

6950 SCANNING WITH POSITRON-EMITTING RADIOISOTOPES: ANEURYSM, ARTERIOVENOUS MALFORMATION, AND INTRACEREBRAL HEMORRHAGE. Ojemann, Robert G.; Aronow, Saul; Sweet, William H. (Massachusetts General Hospital, Boston). J. Neurosurg., 22: 489-98(May 1965).

Positron-emitting isotopes, ^{74}As and ^{64}Cu, were used to perform radioisotopic brain scans on 55 patients with confirmed diagnoses of aneurysm, arteriovenous malformation, and subarachnoid or intracerebral hemorrhage. The appearance of the scan, degree of neurologic deficit, interval of time from onset of symptoms to scan, and angiographic and pathologic findings are correlated. Advantages of the use of these isotopes as compared with ^{203}Hg, ^{131}-albumin, and ^{18}F are discussed. The radioisotopes

were administered by intravenous injection, and the scan usually performed about 1 hr after injection. Arsenic-74 will reveal an area of increased concentration in a high percentage of patients with aneurysm and subarachnoid hemorrhage associated with some degree of neurologic deficit. The outline of the aneurysm is not visualized but changes in adjacent cerebral tissue caused by either hemorrhage or infarction are demonstrated. The two types of lesions are not differentiated from each other. Copper-64 was not as effective as the ^{74}As. Arteriovenous malformations were associated with an increased concentration of ^{74}As. In patients with intracerebral hemorrhage, ^{74}As localized the area of the hematoma with a high degree of accuracy. Increased concentration was found principally in the tissue adjacent to the hematoma. In the 2nd and 3rd weeks after onset, all hematomas were correctly localized, possibly indicating progressive alteration of the blood-brain barrier and a widening zone of damage following the hemorrhage. (BBB)

6951 THE USE OF IONIZING RADIATION IN SURGERY. Lipkan, E. F.; Oderii, S. N.; Sivachenko, T. P. (Postgraduate Medical Inst., Kiev). Klin. Khirurgiya, 11: 3-9(1964). (In Russian).

Radiological methods complemental to surgery are surveyed. Use of radioisotopes and ionizing radiation sources for diagnosis and therapy are included. (H.G.D.)

6952 SOME RESULTS OF BETA THERAPY OF EPIBULBAR TUMORS. Lommatzsch, P.; Vollmar, R. (Humboldt-Univ., Berlin). Klin. Monatsbl. Augenheilk., 144: 856-71(1964). (In German).

Treatment of tumors in the anterior portions of the eye with β applicators containing $^{90}Sr-^{90}Y$ or $^{106}Ru-^{106}Rh$ is described. Isodose curves and range of depth effects are compared for each type of source used. The authors described effects of applicators used to treat patients with various types of eye tumors. The applicators contained from 7 to 40 mC of activity, and the dose rate varied from 125 to 1000 rad/min. The daily dose used amounted to 1000 rad, and the total surface dose administered amounted to 6000 to 15000 rad. In cases where the tumor extended to the conjunctiva or the eyelids a supplemental dose of low voltage x irradiation of about 6000 R in single doses of 200 R was given. For epibulbar melanomas the total dose administered was between 8000 and 15000 rad. In two cases of melanosis conjunctivae the total doses administered were 8000 and 10000 rad. For pigmented naevi of the conjunctiva 10000 rad was administered. A similar dose was administered for epibulbar carcinoma. Only 6000 rad was administered for epibulbar hemangioma. (BBB)

6953 PROBLEMS OF PROTECTION FROM RADIATION IN THE EMPLOYMENT OF RADIOACTIVE NUCLIDES IN OPHTHALMOLOGY. Hegewald, H.; Lommatzsch, P. (Humboldt Univ., Berlin). Klin. Monatsbl. Augenheilk., 146: 76-86(1965).

Some dosage measurements in the practical management of radionuclides in ophthalmology have revealed that the use of beta-applicators has to be regarded as not dangerous, if comparatively simple protective measures against radiation are taken. With the use of ^{60}Co sources, the treating physician is exposed to a relatively high radiation charge which can only be diminished by a limitation in the handling periods of these applicators. (Excerpta Med.)

6954 POLYCYTHEMIA VERA: COMPARISON OF SURVIVAL AND CAUSES OF DEATH IN PATIENTS MANAGED WITH AND WITHOUT RADIOTHERAPY. Halnan, K. E.; Russell, M. H. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Lancet, 2: 760-3(Oct. 16, 1965).

There was no significant difference between the survival rate of 107 patients with polycythemia vera treated with whole-body x-ray therapy and radiophosphorus, and that of 117 patients treated without radiotherapy. The causes of death were similar in the two series, except that death from hemorrhage (other than cerebral) occurred only in the nonirradiated group. There were no cases of leukemia in either series. (TCO)

6955 IN-VIVO METHOD FOR DETECTING ANTIMONY DEPOSITS IN THE LUNG BY DIFFERENTIATED ABSORPTION OF X-RADIATION. McCallum, R. I.; Day, M. J. (Univ. of Newcastle upon Tyne, Eng.). Lancet, 2: 882-3(Oct. 30, 1965).

A new method, employing ^{125}I as a radiation source for x-ray spectrophotometry, was developed for detecting Sb deposits in the lungs in miners or workers exposed to the metal. Iodine-125 was used as a source of Te K x rays. This nuclide decays by capture of one of its K electrons, forming ^{125}Te, which subsequently emits its characteristic x-ray spectrum. This provides a very compact and convenient source of radiation. A scintillation counter was used to determine the relative proportions of K_α and K_β radiation in the beam as it entered the patient, and again as it emerged through the chest. The results were compared with control measurements using water phantoms of various dimensions. The normal tissues should produce a relative enhancement of the K_β component in the mixed beam, and this effect should be annulled by about 40 mg Sb cm^2 of chest area. Effectiveness of the method was proven in several subjects exposed occupationally to Sb. (BBB)

6956 USE OF INTRA-ORAL PROSTHESES IN RADIOTHERAPY. Santiago, Arturo (Univ. of Puerto Rico, San Juan). Med. Rec. Ann., 58: 3-11(Jan. 1965).

Use of intra-oral prostheses to aid in localization of the radiation beam in oral cancer therapy and prevent complications is described. An outline of the procedure followed in the fabrication of these prostheses is given. (TCO)

6957 ESTIMATING THE RADIATION DOSE IN VARIOUS RADIODIAGNOSTIC TECHNIQUES. Gorissen, A. (Sint Annadal Hospital, Maastricht, Netherlands). Medicamundi, 10: 112-16(1965).

An investigation was made of the factors influencing the radiation dose to patients during radiodiagnostic examinations. Various image forming media and methods are tabulated. Measurements were made of the skin dose and maximum dose absorbed by the body for various input doses (for image formation) in fluoroscopy, using the Rotalix 090 1.2–0.3 for 125 kv and an object phantom consisting of pertinax plates. The measuring arrangement is described. It is found that for a constant average image brightness or film density the dose to which the patient is exposed generally decreases with: higher tube voltage; smaller or no grid factor; smaller object thickness, smaller irradiated volume, heavier filtration, and longer focus-image distance at minimal object distance. Comparisons are made of the average input doses for different examination methods and the diagnostic information that can be obtained from a given radiation dose. (L.B.S.)

6958 POLYCYTHEMIA VERA AND LEUKEMIA—THE ROLE OF RADIATION TREATMENT: A STUDY OF 1222 PATIENTS. Modan, Baruch; Lilienfeld, Abraham M. (Johns Hopkins Univ., Baltimore). Medicine, 44: 305-44(July 1965).

To evaluate the possible leukemogenic effect of ^{32}P and external radiotherapy, a survey was made of 512 patients with polycythemia vera (PV), 476 with polycythemia of a questionable nature, and 234 with polycythemia secondary to lung disease. A comparison was made between the risk of developing leukemia in the groups treated with ^{32}P and/or x ray and those receiving no radiation treatment. Eleven percent of the ^{32}P and 8.9% of the x-ray treated PV patients developed acute leukemia compared to less than 1% in the nonradiation treated group. A similar excess was found among the ^{32}P-treated patients in the questionable polycythemia group. The increased risk of acute leukemia appeared to be dose dependent. The number of patients in the secondary polycythemia group receiving ionizing radiation treatment was too small to permit firm conclusions. One patient was found to have developed acute leukemia following x-ray treatment. Two additional patients with secondary polycythemia developed acute leukemia following ^{32}P, but this occurred after the set termination date of the study. The survivorship of patients with PV and other

forms of polycythemia was analyzed. It was demonstrated that other factors, including the different time sequence between the onset of the disease and ^{32}P treatment, influenced the comparisons regarding the length of survival reported in the literature and led to an artificially exaggerated difference between the length of survival of the ^{32}P-treated patients and those treated otherwise. After adjusting for these factors, the improvement in the length of survival of ^{32}P-treated patients seems minimal. These findings, in addition to other observations presented indicate that the increased risk of leukemia does not necessarily follow a prolonged survival. (BBB)

6959 LOCALIZATION STUDIES OF A BRAIN TUMOR BY MEANS OF PROBING NEEDLE G-M COUNTER. Saito, H.; Masuda, K.; Otomo, S.; Kurosawa, M.; Takaoka, Y. (Juntendo Univ., Tokyo). Neurol. Med. Chir., 5: No. 1-8, 47(1963).

The localization of brain tumors by a needle G.M.-Tube was studied in 46 cases with intracranial lesion at operation. Radioactive phosphorus ^{32}P was administered intravenously about 15 hr. before the operation. Counting ratios of brain tumors were compared with normal brain tissues. The localization of the brain tumor was verified in 24 cases of 40 brain tumors. High concentrations of ^{32}P were observed in metastatic carcinoma, heterotopic malignant hypophyseal adenoma, astroblastoma, oligodendroglioma, craniopharyngioma, and meningioma. Local diagnosis by the method was of little value in acoustic neurinoma, hypophyseal adenoma, and intracranial hematoma. (TCO)

6960 CURRENT CONCEPTS IN THERAPY: THE TREATMENT OF HYPERTHYROIDISM. Chapman, E. M. (Massachusetts General Hospital, Boston). New Engl. J. Med., 265: 744-5, 844-7, 948-51(Oct. 12 and 26, Nov. 9, 1961).

Extensive data are presented on the ^{131}I treatment of hyperthyroidism, including information on hazards and contraindications, dose estimation, and late effects. Although the fetal uptake of radioiodine does not begin until the fourth month of pregnancy, the author does not advise this treatment during pregnancy and advises against its use in those below a predetermined age because of possible genetic damage. The actual age limits have varied since age restrictions were introduced. At first, it was up to 45 years; more recently, it has been reduced from 40 to 25 years. However, the number of children now treated offers a significant group for observation on the biologic effects of radiation. The late effects of this radiation will be revealed in time, but so far, the occasional occurrence of nodules of regenerative hyperplasia or adenomas has been most significant. The past decade has seen a rapid rise in its use so that, by 1961, it is estimated that almost 100,000 persons have been treated with ^{131}I. After 20 years of use, the fear of producing carcinoma or leukemia has not been substantiated. The main hazard is overtreatment, producing myxedema, which occurs in about 10% of those treated. Under-treatment requires a second dose, seldom a third. Second doses should not be administered before the fourth month after the first dose. Radiation thyroiditis, headaches, falling hair, and aching teeth are transitory reactions. Doses of radioiodine have been decreased in the hope of reducing the incidence of myxedema and yet accepting a possible increase in need for second doses. The average single effective dose administered has decreased from 8.0 to 6.5 mC. Doses of 4.0 mC are often given to untreated patients with barely palpable goiters. The average administered dose of 160 μC of ^{131}I per estimated g of thyroid tissue results in an average single effective retained dose of 120 μC/g. Measured urinary radioactivity after therapy indicates that 200 μC/g or more are retained by those in whom myxedema develops. Patients with heart disease and normal thyroid function, however, require retention of 300 μC or more to attain the same clinical result. (TCO)

6961 A QUANTITATIVE STUDY OF SCATTERED RADIATION FOG ON LOW- AND HIGH-SPEED DENTAL ROENTGENOGRAMS. Shawkat, Abdul Hamid L. (Cairo Univ.). Oral Surg., Oral Med., Oral Pathol., 20: 42-55 (July 1965).

A quantitative study of scattering in dental radiography presents: a quantitative method of measuring secondary radiation fog on low- and high-speed dental films; the effects of fog on image contrast; results of clinical appraisal of dental roentgenograms as related to secondary radiation fog; and a determination of the optimal combination of physical factors which will produce roentgenograms with the least amount of fog and the most desirable contrast. (TCO)

6962 CLINICAL FINDINGS ON THE INTRA-ARTERIAL INJECTION OF ^{32}P-LABELLED RESIN MICROSPHERES. Dogliotti, A. M.; Caldarola, L. (Univ., Turin). Panminerva Med., 7: 97-102(Apr. 1965).

Experimental and clinical data on the use of stably ^{32}P-labeled cation exchange resin microspheres as a β source for tumor therapy are reported. The particles have an average diameter of 50 μ and their specific gravity is similar to that of blood. The ^{32}P is adsorbed on the resin in the form of a colloidal chromium compound. After animal experiments the technique was employed in 72 cases. The value of this intra-arterial irradiation technique lies in the fact that the microspheres are distributed uniformly throughout the precapillary and capillary beds of the area of interest without harming normal tissues. In tumors of the chest wall, injection is made into the subclavian artery. The ascending blood vessels are temporarily excluded with clamps and a tourniquet is applied to cut off the arm circulation. The organs best suited to this type of treatment are the tongue and kidney. This is because of their particular terminal-type vascularization which enables the microspheres to be distributed within the tumor. For the tongue 20,000 to 40,000 microspheres (delivering 4 to 12 mC of ^{32}P) are used. The method can be used for tumors of the lungs and abdominal organs if injection is done selectively both by percutaneous catheterization and, more effectively, by surgical isolation of the tributary arteries of the organ and the portion thereof occupied by the tumor. The microspheres can be concentrated in certain pelvic organs, such as the uterus and bladder, without causing occlusion of the capillary bed. For example, in a case of cervical carcinoma in which injection was made into the internal iliac arteries with exclusion (by means of temporary clamping) of all the collaterals and branches supplying the uterine body, 92% of the radioactivity was found in the cervix, and autoradiography revealed numerous focal areas of radioactivity in the cervix but none in the corpus. Of the 76 patients treated, 52 are still alive from one to 8 months after treatment. A temporary improvement in general condition with alleviation of, or complete relief, from pain was obtained in 47 patients. In 22 there was a temporary regression of the tumor. (BBB)

6963 RADIOISOTOPE NEPHROGRAPHIC STUDIES IN PARAPLEGICS. Paeslack, V.; Roehl, F.; zum Winkel, K. (Univ., Heidelberg). Paraplegia, 2: 246-54(Mar. 1965).

A method using ^{131}I-Hippuran was developed for assessing renal function in the paraplegic patient. Animal studies were also conducted to aid in interpretation of the clinical findings. The test is conducted by intravenous injection of 0.3 μC of ^{131}I-Hippuran per kg body weight and the immediate accumulation of the substance and its discharge is followed with a ratemeter in the following 30 min after the injection and is recorded. The isotope nephrogram gives an estimate of the function of each kidney. Moreover, disturbance of individual phases of kidney function can be distinguished. This method gives a clear picture of tubular function, which is so important in assessing kidney function in a paraplegic. The procedure is not strenuous for the patient and is without risk. It requires less than 1 mg of the test substance. This method can also be employed without any risk to patients with considerable kidney damage. This test is not dependent upon the emptying of the bladder and does not require catheterization. So far, no contraindications have been found. (BBB)

6964 CHANGES IN HEMATOLOGIC PATTERNS AFTER RADIUM THERAPY AND SURGICAL TREATMENT OF UTERINE NEOPLASIA. Chisale, E. (Ospedali Galliera, Genoa). Pathologica, 55: 261-3(July-Aug. 1963). (In Italian).

The effect of radiotherapy on blood cell levels is usually the limiting factor in this form of treatment. Changes in hematologic parameters were followed in 11 women with uterine cervical carcinomas before and after radiotherapy and surgery. Radium implantation, hysterectomy, and external ^{60}Co irradiation were given, in that order. Determinations included red and white cell counts (and differential counts), hemoglobin, and hematocrit. Decreases were noted in erythrocytes, from 4.26 (before treatment) to 3.98 (after treatment) million cells/mm^3; total leukocytes, from 7260 to 5380 per mm^3; neutrophils, from 4220 to 3830; mononuclears, from 3200 to 1490; and hemoglobin, from 83 to 75. No change in hematocrit was noted, but the other changes were significant. The results indicate that radiotherapy has a more depressant effect on mononuclear cells (lymphocytes + monocytes) than on other peripheral blood cells. Also, the depression of mononuclear cells after irradiation tends to persist longer; two months after radiotherapy the counts of these cells were still low whereas total leukocyte and erythrocyte counts were nearly normal. (BBB)

6965 THE USE OF THE GRID IN SUPERVOLTAGE THERAPY. Becker, J.; Kuttig, H. (Univ.-Strahlenklinik, Heidelberg). Progr. Radiat. Therapy, 3: 50-67(1965).

The use of the grid to reduce deep tissue injury in supervoltage radiotherapy is discussed. Radiobiologic investigations of healthy tissue following grid therapy, particularly of the skin, demonstrated a different reaction than that which follows homogeneous irradiation. The 2-year survival following the treatment of 160 patients with bronchial carcinomas using telecobalt grid was 8.5%, compared to 10.2% in 104 treated homogeneously with tumor doses in excess of 5000 R. It is concluded that grid irradiation with supervolt therapy has a definite justification. Advantages of the method are presented. (TCO)

6966 LYMPHOMA IN CHILDREN. Schneider, Martin (Univ. of Texas, Galveston). Progr. Radiat. Therapy, 3: 172-82(1965).

Advantages of radiotherapy for lymphomas in Stages I and II are compared with those of surgery. A review of 613 patients of all ages, with lymphosarcoma in Stages I and II, revealed that postirradiation survivors exceeded postsurgical ones by ~2:1 margins, and that 4 of the 6 patients living for long periods after radical neck dissections (on 19 patients) had required x-ray therapy for recurrences. Among the author's cases (37, only two of which were treated surgically), 39% 5-yr survival was obtained. In no long-term survivor of lymphoma has a serious sequela been reported after proper administration of radiotherapy. (TCO)

6967 PRESENT STATUS OF COMBINED RADIATION THERAPY AND CHEMOTHERAPY. Kligerman, Morton M. (Yale Univ. School of Medicine, New Haven). Progr. Radiat. Therapy, 3: 183-99(1965).

The difficulty of finding drugs with a true synergistic effect for use in radiotherapy is discussed. At present, radiation alone remains as the most powerful cancerocidal agent. Obstacles such as the lack of drugs with powerful radiopotentiating abilities have hindered observance of clear-cut synergistic effects in clinical reports. Reports of radiation combined with various types of drugs are reviewed, and 72 references are cited. (H.G.D.)

6968 QUANTITATIVE STUDIES OF IODINE METABOLISM IN THYROID DISEASE. Alexander, W. D.; Koutras, D. A.; Crooks, J.; Buchanan, W. W.; MacDonald, E. M.; Richmond, M. H.; Wayne, E. J. (Western Infirmary, Glasgow). Quart. J. Med., 31: 281-305(July 1962).

Fundamental studies on radioiodine metabolism were undertaken as a basis of better understanding of results of clinical ^{131}I tests. This report describes in detail the technique of measurement of the plasma inorganic iodine (PII) and the absolute iodine uptake (AIU); it establishes normal and pathological ranges, and checks the reproducibility of results. It describes how the changes which occur in different types of thyroid disease are brought about, and examines the value of measurements of diagnosis using ^{131}I. Theoretical basis of the methods is examined. The radioiodine uptake of the thyroid gland at 2½ hr was estimated after a tracer dose of 50 μC of ^{132}I given orally while fasting. In about 10% of cases 25 μC of ^{131}I was used instead, when this isotope was required for other reasons (particularly for estimation of protein-bound ^{131}I at 48 hr). Measurements with the two isotopes were found to be comparable. The thyroid clearance of ^{132}I was also estimated. The results showed that in thyrotoxicosis the thyroid clearance and absolute uptake of ^{131}I are greatly increased. The plasma inorganic iodine is slightly diminished, probably owing to increased loss of iodine in the feces and increased renal clearance. In patients with simple goiter the mean level of plasma inorganic iodine is lower than in normal subjects, but the thyroid clearance of iodine is increased, so that the absolute uptake of iodine lies within the normal range. The urinary excretion of iodine is decreased. Considered as a group, patients with simple goiter have a reduced intake of iodine due mainly to a diminished consumption of fish. The findings are unlike those which would be expected if enzyme defects or dietary goitrogens were important etiological factors. In autoimmune thyroiditis the thyroid retains a normal amount of radioiodine, but produces a subnormal amount of thyroid hormone. Abnormal butanol-insoluble iodoproteins and defective organic binding of trapped iodine may occur. In primary hypothyroidism the uptake of radioiodine by the thyroid is reduced, and the level of serum protein-bound iodine is low. The plasma inorganic iodine is within normal limits, but renal clearance of iodide is below normal. In inborn errors of iodine metabolism (dyshormonogenesis) associated with faulty utilization of iodine, the absolute uptake of radioiodine by the gland is increased, but only a proportion is converted to thyroid hormone. The plasma inorganic iodine is normal; the serum protein-bound iodine is normal or reduced. (BBB)

6969 THE RADIOISOTOPIC RENOGRAM. Witcofski, R. L. (Bowman Gray School of Medicine, Winston-Salem, N. C.). Radiol. Clin. N. Amer., 3: No. 1, 29-39 (1965).

The use of the renogram as a screening test for detecting renovascular hypertension or for following the courses of pyelonephritis or obstructive uropathy is evaluated. Advantages of the method are: utility with very ill patients; exposure of the patient to much smaller radiation doses; and the economic and rapid indication of renal function. (H.G.D.)

6970 CHEMICAL RADIOSENSITIZATION. van Bekkum, D. W. (Institut de Radiobiologie TNO, Rijswijk, Netherlands). Rev. Franc. Etud. Clin. Biol., 9: 993-6 (Nov. 1964). (In French).

The possibilities of using chemical agents to enhance the response of malignant cells to ionizing radiation are considered. 5-Halogenated deoxyuridines can be substituted for thymidine in the DNA of mammalian cells, increasing the radiosensitivity of DNA in proportion to the amount of the substituted analog. But, to be incorporated in DNA the level of deoxyuridine in the blood and tumor must be high enough to compete with the normal thymidine reserve. This level must be maintained over several replication cycles, that is, several days. It has been reported that 5-bromodeoxyuridine inhibits cell division and decreases viability. If this is so, it cannot be considered as a radiosensitizer. Tests with tetrasodium 2-methyl-1,4-naphthohydroquinone diphosphoric acid ester (Synkavit) have shown it to be an antimitotic but not an effective radiosensitizer. Like ionizing radiations, actinomycin D destroys the power of human cancer cells to reproduce indefinitely. It has been suggested that it can potentiate the effect of x rays, but there is no evidence to support this. Iodoacetic acid and N-ethylmaleimide have been proposed as x-ray potentiators, but

not enough data are available for proper evaluation. There is also no convincing proof that dyes such as eosin, fluorescein, and the hematoporphyrins possess radiosensitizing properties. At most, the above compounds might have a synergistic action with ionizing radiations. These compounds reach tumors by way of the blood stream. Circulation in tumors is less than in the normal adjacent cells, so it is probable that any radiosensitizing chemical would make normal cells more sensitive than tumors. (BBB)

6971 LONG REMISSION AFTER X-RAY IRRADIATION AND TRANSFUSION OF BONE MARROW IN A PATIENT WITH LYMPHOSARCOMA. Miller, D. G. (Sloan-Kettering Cancer Center, New York). Rev. Franc. Etud. Clin. Biol., 10: No. 1, 84-6(1965).

Six years after the initial diagnosis of lymphosarcoma, a 45-year-old male had generalized progression of the disease with bulky regional lymphadenopathy, bone marrow invasion, and pancytopenia. The lymph nodes were treated by local x-irradiation with 900 R. Following this the lymph nodes regressed but the hematological picture became progressively worse. The patient then received a transfusion of bone marrow from a donor with sickle cell trait. There was a gradual improvement in the peripheral blood and bone marrow and all hematological values returned to normal. The liver and spleen and palpable lymphoid masses also decreased in size with no treatment. The improvement seen in this patient, especially in the bone marrow, cannot be attributed to the localized irradiation of lymph nodes. While the improvement may have been spontaneous, one may also consider the possibility that it was the result of a graft versus host reaction following the transfusion of allogenic bone marrow. This is the only instance of such improvement seen in 21 bone marrow transfusions performed in 13 patients with leukemia or lymphoma. (TCO)

6972 SHIELDED APPLICATOR FOR CURIETHERAPY OF CANCER OF THE VAGINA. Crinelli, A.; Renzi, R. (Univ., Florence). Riv. Ostet. Ginecol., 16: 664-72 (Nov. 1961). (In Italian).

A series of vaginal applicators which provide shielding for adjacent healthy tissues during intraluminal irradiation with ^{60}Co sources are described and illustrated. The cylindrical-shaped Plexiglas applicators are equipped with inner lead shields 1.3-cm thick (the 1.5-Mev γ emission of ^{60}Co requires 1.2 cm of lead for adequate shielding). The Plexiglas cylinders are 8 cm long, 3 cm in diameter, and their walls are 2 mm thick. A narrow central canal accommodates the source. Dosimetric studies using phantoms were made to show the distribution of radiation with various shaped shields. Isodose patterns are shown for shields with various shaped windows. Results of both ionization meter and film studies illustrate how the dose can be largely confined to the sector containing the tumor to be irradiated. The system described is very simple in both construction and application, and is adaptable to treatment of localized as well as infiltrating tumors. (BBB)

6973 PLACENTAL LOCALIZATION AND ASSESSMENT OF FETAL WHOLE BODY AND GONADAL RADIATION FOLLOWING $R^{131}ISA$ PLACENTOGRAPHY. te Groen, F. W.; Jansen, C. R.; van der Merwe, C. J.; Geldenhuys, F. G. (Univ. of Pretoria). S. Afr. J. Obstet. Gynecol., 3: 46-9(Sept. 4, 1965).

A whole-body counter was used to estimate the maternal and fetal doses during placentography with 5-μC doses of radioiodinated (^{131}I) serum albumin. The average placental crossing of RISA is about 1.75% of the administered dose. From a dose of 5 μC of $R^{131}ISA$ injected into the mother, the radiation dose to the fetus was calculated to be 5 mR. If the fetal thyroid is not blocked by Lugol's iodine solution, the radiation dose to the fetal thyroid will be about 4.9 rad, 2% of the administered activity being concentrated in the fetal thyroid. Thus Lugol's iodine solution must always be used as a thyroid-blocking agent before doing a placentogram. Of 5 μC injected into the mother, an average of 0.006 μC of ^{131}I crosses the placenta. The total body and gonadal dose to the fetus will be 0.005 R. Radiographic placental localization, using the conventional 2-film method, results in a total fetal body dose of 2.4 rad. (TCO)

6974 RECONSTRUCTION OF THE EXTERNAL GENITALIA FOLLOWING TRAUMA. Stickey, James G. S. Med. J., 57: 1139-42(Oct. 1964).

Plastic surgical repair of the external genitalia after radiation-induced injury is described. In a 31-yr-old woman, six x-ray treatments were given for a benign condition, urethral prolapse (radiation dose not stated), resulting in partial, but not complete relief of her symptoms. About a year after irradiation the symptoms returned and she began to have bleeding from the urethra. An attempt was made to excise the urethral mucosa and cover the defect with a skin graft. The graft did not take and the wound was slow in healing because the tissue had been damaged by x rays. The patient developed stress incontinence and was advised to have her ureters implanted in an ilial pouch but this was refused. Eleven yr later, on the basis of continued discomfort, a suprapubic cystostomy was done to divert the urinary stream. The urethra was dilated and the area of involved mucosa was excised to a depth of about 3 mm, without damage to the underlying muscles. The area of excision extended back to the bladder neck. A large flap was outlined, using the labium minus on the right side. This was elevated, turned into the defect, sutured in position, and the flap bed closed primarily. One week postoperatively the suprapubic cystostomy tube was removed, and a catheter was inserted in the urethra. This catheter was removed three days later, and the patient was able to void without difficulty. All of the symptoms of pain, discomfort, stress incontinence completely disappeared in a few weeks. Areas of x-ray burn in any part of the body are managed best by excision of the involved area and rotation of a local skin flap into the defect, bringing along its own blood supply. This principle was applied to the urethra by using the adjacent labium minus. The flap was made large enough to increase the length of the urethra, thereby relieving the patient's stress incontinence. (BBB)

6975 FUNDAMENTALS OF CUTANEOUS RADIOTHERAPY. Bourdon, R.; Flori, D.; Beix-Froissard, F. (Hopital Saint-Louis, Paris). Sem. Hop. Paris, 40: 3040-55(Dec. 1964). (In French).

Radiotherapy of cutaneous tumors should be based on clinical findings which take into account the age of the patient, the type and size of the lesion, history of previous irradiation treatment, and the radiosensitivity of the lesion. Factors which require consideration for this type of treatment are the histological nature of the lesion, the possible radiobiological effects of radiotherapy in terms of the dose rate, fractionation, absorbed dose, and the tissue distribution of the dose. Other physical factors need to be considered, such as time factors and tissue reactivity to irradiation, geometric considerations of irradiation exposure technique which take into account the topography and volume of the tumor, etc. The effectivity of cutaneous radiotherapy requires testing in statistical terms, where factors including tumor recurrence rates and appearance of necrotic tissue are most important. (BBB)

6976 POSSIBILITIES FOR TELECOBALT THERAPY OF SPINAL COLUMN WITH CURATIVE DOSES. Kuttig, Helmut (Univ.-Strahlenklinik, Heidelberg); Pini, Mario; Sunaric, Dejan. Strahlentherapie, 2: 241-6(Oct. 1965). (In German).

Procedures for telecobalt radiation therapy of tumors of the spine with high doses, using the best possible protection of the spinal cord, are reported. The requirements were fulfilled by radiation through two oblique areas with a wedge shaped filter and pendulum radiation at an angle of 120° in the area of the spine with simultaneous protection of the skin with lead. (tr-auth)

6977 INVESTIGATIONS WITH IONIZATION CHAMBERS AND FILM BLACKENING FOR DETERMINATION OF ISODOSES FOR PENDELUM IRRADIATION WITH ECCENTRICALLY LOCATED PENDELUM AXIS FOR ULTRAHARD

X RADIATION FROM A 17-Mev ELECTRON ACCELERATOR (BETATRON). PART II. MANTLE IRRADIATION WITH 17-Mev X RADIATION. Heinzler, Franz (Medizinischen Akademie, Duesseldorf). Strahlentherapie, 2: 247-63(Oct. 1965). (In German).

Using a lucite phantom, the geometrical dose distribution of shell x radiation from a 17-Mev-betatron was determined photometrically using ultrahard rays. The determinations were done under the following conditions: symmetrical and asymmetrical pendulum angles and different axis depths. The following results were obtained: The length of the isodoses depends on the pendulum angle; the depth, that is the distance from the surface of the phantom to the 50 %-isodose, was determined by the lead diaphragm, and the surface dose was about 50% of the maximum dose value. A method for the determination of the axis depth, for the required aperture angle, and for calculating the focal dose is described. In cases of inoperable carcinoma of the breast, the method described is thought to be the most conservative one at the present time. (tr-auth)

6978 AN AID FOR DETERMINING TREATMENT OF LIVER CANCER BY COMBINED HEPATIC GAMMASCANNING. Ariel, Irving M. (Pack Medical Foundation, Inc., New York). Surg. Gynecol. Obstet., 121: 267-74(Aug. 1965).

Use of radioisotope methods to evaluate the effectiveness of therapy for liver cancer is described. Hepatic photoscanning, after the administration of certain radioisotopes is a useful method to detect space-occupying lesions within the liver. The most frequently employed isotopes are ^{131}I-rose bengal and colloidal ^{198}Au. Concentration of ^{131}I-rose bengal is a function of the parenchymal hepatic cells; colloidal ^{198}Au is concentrated largely by the reticuloendothelial system. Performing a combined scan with ^{131}I-rose bengal and ^{198}Au results in a graphic visualization of the hepatic parenchyma and the functional Kupffer cells. Accordingly, the combined gamma or photoscan is useful for determining the extent of cancer within the liver, as well as the quantity of functional parenchymal liver cells and, therefore, is helpful in determining treatment policies. Examples from 175 patients with intra-abdominal cancer serve to demonstrate the application of hepatic photoscanning in the clinical management of the patient with hepatic cancer, either primary or metastatic. (TCO)

6979 ON THE EFFECT OF THE SERUM IODIDE CONCENTRATION ON THE IODIDE UPTAKE CAPACITY OF THE NORMAL HUMAN THYROID. Fitting, W. (Evangelisches Krankenhaus, Cologne). Symp. Deut. Ges. Endokrinol., 9: 145-8(1963). (In German).

The absolute ^{131}I uptake of the thyroid is a function of the concentration of inorganic serum I and the ^{131}I clearance of the thyroid. Increases in the concentration of serum I result in an increased ^{131}I uptake. Thus the magnitude of the absolute value of ^{131}I uptake is directly proportional to the serum I concentration. This proportionality holds over a range of about fourfold the normal serum I concentration, but at concentrations greater than this the absolute value of ^{131}I uptake no longer varies linearly. It can be increased by a factor of 10 at most. The absolute ^{131}I increase is limited because the ability of the thyroid cells to take up ^{131}I becomes increasingly reduced by increasing serum I concentration. This mechanism is a very important self regulatory mechanism of the thyroid. Contrast media that contains ^{131}I contributes to increases in the serum I concentration, and thus affect the ability of the thyroid to incorporate ^{131}I and the absolute value of the ^{131}I uptake of the gland. (BBB)

6980 THE PLACE OF RADIOACTIVE CHROMIUM IN THE DIAGNOSIS OF BLOOD DISEASES. Gerede, R. S. Turk Tip Cem. Mecmuasi, 30: 749-53(1964).

The various radioactive isotopes used as erythrocyte tagging agents are briefly discussed. In vitro and in vivo techniques of the radiochromium method are described, and ^{51}Cr red cell survival results in certain blood diseases are presented in the light of literature data. (Excerpta Med.)

6981 METHOD FOR CLINICAL STUDIES OF VESICOURETERAL REFLUX USING COLLOIDAL ^{198}Au. Berne, E.; Ekman, H. (Univ. of Goeteborg, Sweden). Urol. Intern., 18: 335-46(1964).

A new radioisotope method was developed for detecting ureteral reflux from the bladder. The patient with the bladder catheterized is placed in the supine position. A scintillation detector with a collimator, having a visual field of around 8 cm at a distance of 10 cm from the collimator tip, is positioned over the pelvis of one of the kidneys. When the recording is in progress, 25 to 300 μC (usually 100 μC) of colloidal ^{198}Au in a few ml of physiological saline is introduced into the catheter and after a minute or two a check is made that no rise occurs in the activity over the kidneys. The solution of colloidal ^{198}Au is then introduced into the bladder from the catheter, when the slow filling of the bladder with physiological saline starts. The filling is continued until a volume of 100 ml has been injected. The activity is continuously recorded during the course of this filling. After a brief interruption in instillation, a further 100 ml is infused. The bladder is filled to capacity in this manner, and then emptied through the catheter. The bladder is subsequently washed with three to four 50-ml volumes of physiological saline. The activity is also recorded continuously during both the emptying and irrigation phases. The following advantages are considered for this isotope method: the use of ^{198}Au permits observations continuously over very long periods; the frequent observations make a more thorough study of the ureteral reflux possible, especially in complicated cases and for research purposes; quantitative examination is possible, and the method is very sensitive. Prolonged x-ray examination consisting of voiding cystography with numerous exposures is disadvantageous from the standpoint of irradiation, especially in children and young persons. The radiation dose may be considerable on each occasion. In voiding cystography the mean dose to the testes and ovaries is around 1.0 R for each pair of exposures, or 9.0 R for each examination. If the examinations are repeated, the danger may be considerable. In an isotope examination the radiation dose to the wall of the urinary bladder during an examination of 15 to 20 min duration is relatively small as compared to that of voiding cystography. (BBB)

6982 DOSIMETRIC STUDY OF COMBINED RADIUM THERAPY AND IRRADIATION OF CERVICAL CANCER. A COMPARATIVE STUDY OF THE VARIOUS THERAPEUTIC TECHNIQUES BY PHANTOM MEASUREMENTS (CORPSES) AND MEASUREMENTS WITH THE AUTOMATIC ISODOSE PLOTTER. De Roo, M. Verhandel. Koninkl. Vlaam. Acad. Geneesk. Belg., 26: 411-568(1964).

A technique for radiotherapy of cervical carcinoma is described that provides for the entire pelvis to be covered with a large and homogeneous volume of rays composed of a moderate anti-cancer dose. Completing the treatment is a local super-dose administration on the level of the primary lesion. During studies of local therapy, the use of separate Ra applicators was contrasted to use of ^{60}Co rods. Data were collected on the effects of applicator position on dose repartition in the pelvis area. Neither of the two methods showed favorable dose repartition. (H.G.D.)

6983 THE IMPORTANCE OF THE SIZE OF AN INTRAOCULAR TUMOR FOR THE RADIOPHOSPHORUS DIAGNOSIS. Gorskii, L. A. (Pirogov State Medical Inst., Odessa). Vop. Onkol., 10: No. 9, 77-81(1964). (In Russian).

Experimental study of ^{32}P accumulation and detection possibilities was made in 25 rabbits with a Brown-Pearce tumor in the anterior eye chamber. Radiophosphorus was administered intragastrically at a dose of 25 μC/kg. of body weight. The radioactivity measurements were made using a Geiger window counter after 1, 2, 3 and 4 hr and 1, 2, 3, and 4 days. The highest uptake difference between the tumorous and control eye was found at 4th hr. It was possible to detect tumors of diameter larger than 4 mm in vivo, though the measurements on the tumors obtained from enucleated eyes showed substantially higher activity in comparison with the plasma and other tissues. (Excerpta Med.)

6984 PERSONAL EXPERIENCE WITH TREATMENT OF POLYCYTHEMIA VERA WITH RADIOACTIVE PHOS-

PHORUS. Hennig, K.; Franke, W.-G.; Strietzel, M. (Carl Gustav Carus Medical Academy, Dresden). Z. Gesam. Inn. Med. Ihere Grenz., 20: No. 1, 14-20(1965).

Good results were obtained in 40 patients with polycythemia vera, treated with ^{32}P. Results of treatments according to sex and symptoms corresponded with the literature. The observed abolition of thrombophlebitic and thromboembolic complications is of special significance for the duration of the patient's life. The removal of the serious painful hypoxemic conditions, the improvement of the ability to walk, and the possibility of disappearance of a gangrene, stress emphasize the therapeutic value of treatment with radioactive phosphorus even in cases complicated by peripheral angioörganopathy. Sudden corpuscular depressions were seen sporadically in the course of therapy, but they were quickly and completely reversible. (TCO)

6985 ROENTGEN- UND KERNPHYSIK FUER MEDIZINER UND BIOPHYSIKER. 2. AUFLAGE. (X-Ray and Nuclear Physics for Medicine and Biophysics. 2nd Edition). Clocker, Richard; Macherauch, Eckard. Stuttgart, Georg Thieme Verlag, 1965. 532p. DM 69,–.

In the first half of the book the physical data of x-ray and nuclear radiation are discussed, whereas in the second half the use of the various types of radiation are considered. The question of dosimetry and radiation protection are discussed in detail. X-ray diagnostics and therapy are discussed. The use of radioisotopes as tracers and in therapy is considered. (J.S.R.)

6986 RADIOACTIVITY IN MAN. SECOND SYMPOSIUM, WHOLE BODY COUNTING AND EFFECTS OF INTERNAL GAMMA RAY-EMITTING RADIOISOTOPES [SEPT. 5-7, 1962, CHICAGO]. Meneely, George R.; Linde, Shirley, Motter (eds.). Springfield, Ill., Charles C Thomas, 1965. 674p. $24.50. (CONF-362).

Separate abstracts were prepared on 30 papers. Fourteen papers were abstracted previously and appeared in NSA Vol. 16 as numbers 30625, 31469, 31986, 33318, Vol. 17 as numbers 1748, 2799, 2801, 24858, 25620, Vol. 18 as numbers 10427, 16232, and 20337, RDA Vol. 5 as number 58; and RDA Vol. 6 as number 51. (C.H.)

For abstracts of individual papers see: 6748–6754, 6904, 6923, 6987–6996, 7332–7336, 7454–7458, and 7476.

6987 DETERMINATION OF BLOOD VOLUME DISTRIBUTION BY WHOLE BODY COUNTING. Sevelius, Gunnar; Patrick, Daniel R.; O'Connor, Betty; Patrick, Elaine; Coleman, Bill (Veterans Administration Hospital, Oklahoma City). pp 48-51 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

A new whole-body counting technique for determination of blood volume distribution in the body is reported. The technique yields values for chest and legs which compare with those determined by older more conventional methods. It was found that the blood pool in the chest constitutes 40 percent, the blood volume of the head 6 percent, and the blood in the lower legs 10 percent of the total blood volume. (auth)

6988 CLINICAL APPLICATIONS OF WHOLE BODY POTASSIUM DETERMINATION. Lorimer, A. R.; Sinclair-Smith, B. C.; Constantinides, C.; Weiland, R. L.; Ball, C. O. T.; Heyssel, R. M. (Vanderbilt Univ., Nashville). pp 248-62 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Normal values for total-body potassium have been established for race, sex, and age. The Negro has a higher total-body potassium than the white race. The precision of the facility is such that, in repetitive measurements of a normal individual over a long time, less than one in ten of potassium estimations will differ significantly from the mean. The contribution of physiological variation in potassium balance is not known. The whole-body counter is not satisfactory as a day-to-day indicator of metabolic balance of potassium. It confirms trends in the over-all balance of the element. Preliminary work indicates no alteration in total-body potassium in essential hypertension in Negroes. (auth)

6989 INTERRELATION OF BODY POTASSIUM AND BODY WATER IN PATIENTS WITH PRIMARY MUSCLE DISEASE. Blahd, William H.; Cassen, Benedict; Koplowitz, Jerry M.; Lederer, Marianne (Univ. of California, Los Angeles). pp 263-71 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Total-body potassium was determined in fifty-six patients with primary muscle disease (muscular dystrophy and myotonia atrophica) and in forty-two unaffected family members by means of ^{40}K measurements in a whole-body counter. Muscular dystrophy patients had severe depressions in body potassium concentration. Decreased body potassium levels were also observed in myotonia atrophica, but often to a lesser degree. Unusually depressed body potassium levels were noted in some healthy fathers who had dystrophic progeny and in several apparently healthy family members of dystrophic patients. These findings suggest a benign biochemical trait. Total-body water, determined by the tritium dilution method, expressed in relation to total-body potassium and plotted according to age, revealed discrepant values in dystrophic patients. These data support the thesis that intracellular potassium deficiency may be a primary factor in the dystrophic process. (auth)

6990 METABOLISM OF ^{60}Co AND ^{58}Co-LABELED VITAMIN B_{12} IN HUMANS AND RATS. Heinrich, H. C. (Univ., Hamburg). pp 290-330 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Vitamin B_{12} absorption tests are important for the diagnosis of several hematological, neurological, and gastrointestinal diseases. Results are reported from a number of metabolic studies in man and rats in which vitamin B_{12} labeled with ^{58}Co or ^{60}Co and whole-body counting were used. (C.H.)

6991 TURNOVER OF ^{60}Co-LABELED VITAMIN ^{12}B IN PATIENTS WITH PERNICIOUS ANEMIA. Heyssel, Robert M.; Bozian, Richard C.; Darby, William J.; Meneely, George R. (Vanderbilt Univ., Nashville). pp 331-42 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Vitamin B_{12} absorption measured by whole-body counting of ^{60}Co-labeled vitamin B_{12} is simple and reliable. Turnover rates of B_{12} do not vary regardless of the size of body stores, indicating that losses are primarily a first order function. The estimated values for body turnover (around 0.1 percent of body stores per day) of B_{12} accurately predict the time that evidences of B_{12} deficiency would present in gastrectomized patients with previously normal stores of B_{12}. Arguments concerning the correct maintenance dose of B_{12} in pernicious anemia are not answered from these studies. We believe, however, that clinical evidence suggests that there is little merit in high maintenance dosages to normalize body stores or serum levels of B_{12}. The validity of the data with regard to turnover is dependent on the presence of a state of mean equilibrium between labeled and nonlabeled vitamin in the body. (auth)

6992 WHOLE BODY COUNTING TECHNIQUES IN CLINICAL DIAGNOSTIC STUDIES WITH ^{47}Ca, ^{58}Co-VITAMIN B_{12} AND ^{59}Fe. Belcher, E. H.; Robinson, C. J. (Postgraduate Medical School, London). pp 343-59 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Design features of a simple whole-body counting system, incorporating a single scintillation detector, for use in clinical tracer studies are described. The scintillation detector consists of a Tl-activated NaI crystal 7.5 cm × 9 cm and it is coupled to a 13-stage photomultiplier tube. The detector is surrounded by a Pb collimator into which it can be retracted by a rock and pinion mechanism when a collimated counter is required. The output of the photomultiplier is fed to a linear amplifier, a simple channel pulse height analyzer, and a scalar. The pulse height analyzer is aligned so that only counts in the most energetic photopeaks of the γ spectrum of the isotope concerned are recorded. The detector is mounted in a Pb and chalk

shielded enclosure. Results are reported from studies of the gastrointestinal absorption of ^{58}Co-labeled vitamin B_{12}, ^{47}Ca, and ^{59}Fe; and the whole-body metabolism of intravenously injected ^{59}Fe and ^{47}Ca. The geometry of chair and couch counting techniques is discussed. (C.H.)

6993 WHOLE BODY COUNTING TECHNIQUES IN CLINICAL STUDIES WITH ^{58}Co-LABELED VITAMIN B_{12}, ^{131}I-LABELED ALBUMIN, ^{22}Na, ^{59}Fe AND ^{82}Br. Malamos, B.; Belcher, E. H.; Binopoulos, D.; Constantinides, C. (Univ., Athens. Alexandra Hospital, Athens). pp 360-74 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

A technique is described for whole-body counting using a standard chair measurement of radioisotope distribution in human subjects made with a single scintillation detector. Results are reported from measurements of the rate of absorption of ^{58}Co-labeled vitamin B_{12}, the degradation rate of ^{131}I-albumin, the ^{22}Na space and total exchangeable Na, extracellular fluid space measured with ^{82}Br, and ^{59}Fe absorption in both normal subjects and patients. The results obtained by whole-body spectrometry were compared with those obtained by dilution analysis. (C.H.)

6994 NORMAL AND PATHOLOGICAL RADIOIRON EXCRETION IN MAN. Reizenstein, P.; Brann, I. (Karolinska Hospital, Stockholm). pp 391-401 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Results are reported from studies of Fe metabolism and excretion in normal individuals and patients polycythemia vera, menorrhagic bleeding, intestinal bleeding, aplastic anemia, and hemosiderosis in which ^{59}Fe and whole-body counting techniques were used. Patients were studied up to 325 days. The data give information on the relation between Fe losses in different groups of healthy and sick individuals but are not sufficient to establish the Fe requirements or the loss of unlabeled Fe in different groups of people. (C.H.)

6995 STUDIES OF HUMAN IRON METABOLISM WITH A WHOLE BODY COUNTER. McKee, L. Clifford; King, Joseph A.; Hartmann, Robert C.; Heyssel, Robert M. (Vanderbilt Univ., Nashville). pp 402-16 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Methods for determining iron absorption in a single crystal whole-body counter and comparison of results by whole-body counting and stool collection are presented. There is good agreement between the two methods, and it is suggested that absorption as measured by whole-body counting is probably more accurate than collection of fecal excretion except under rigidly controlled circumstances. Normal subjects absorbed from 2 to 13 percent of a fed dose of ^{59}Fe with a mean absorption of 6.7 percent. Three iron deficient subjects absorbed between 30 to 40 percent. Seven patients with paroxymal nocturnal hemoglobinuria absorbed from 16 to 60 percent of fed iron. Total body iron turnover was determined in three normal subjects and six patients with paroxysmal nocturnal hemoglobinuria. The patients with paroxysmal nocturnal hemoglobinuria had much greater iron losses, ranging from 0.21 percent per day to 0.80 percent per day. (auth)

6996 OCCURRENCE OF LEUKEMIA AND LYMPHOMA IN PATIENTS GIVEN THERAPEUTIC DOSES OF RADIOIODINE. Thoma, George E. Jr.; Dorton, Robert K. (St. Louis Univ.). pp 567-73 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

From a total of approximately 100,000 patients treated for thyrotoxicosis with radioiodine during the past twenty years, twenty-three cases of leukemia and four cases of lymphoma have been reported after ^{131}I therapy. The radiation dose to the hematopoietic tissue from 8 mc of ^{131}I is about 10 rad, whereas the beta dose to the hyperactive thyroid from 8 mc of ^{131}I is several thousand rad. Although there is an increasing number of cases of leukemia and lymphoma being reported, it is still difficult to show a positive correlation between the radioiodine therapy and leukemia. Certain atypical features about the small leukemia group are discussed. (C.H.)

6997 A NEW APPROACH TO RADIATION IMAGING. Horwitz, Norman H.; Lofstrom, James E.; Forsaith, Ann L. (Wayne State Univ., Detroit). 31p. (CONF-650647-2). ORINS. Gmelin, AED-CONF-65-197-1.

From Society of Nuclear Medicine, 12th Annual Meeting, Bal Harbour, Fla.

The spark discharge method of imaging was found to be a simple and relatively inexpensive method of obtaining radioisotope distribution patterns. Design features are described of a compact instrument with an oscilloscope camera and collimator integral with a spark discharge chamber. The camera is equipped with a Polaroid pack that permits the observation of sparks during the exposure time. The chamber was applied in the visualization of the thyroid gland after administration of approximately 14 μC ^{125}I and the visualization of the kidney in rats and rabbits using ^{197}Hg-Neohydrin. The development of this imaging device is limited to use with low energy γ rays but it is expected that an increased sensitivity will permit time-lapse imaging. (C.H.)

CHEMISTRY

General

Refer also to abstracts 6694 and 6695.

Analytical Procedures

See also Separation Processes and Procedures

Refer also to abstracts 7104 and 8447.

6998 (AAEC/TM-294) SPECTROGRAPHIC COMPARISON OF BERYLLIUM OXIDE STANDARDS. Dale, L. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). July 1965. 22p. Dep. mn.

Details of a spectrographic comparison of two sets of beryllium oxide standards are given. For most elements satisfactory agreement was obtained, the exceptions being Pb, Cu, Mg, Si (below 100 ppM), and Al (blank correction). (auth)

6999 (AEET-225) SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH 8-HYDROXYQUINOLINE IN ACETONE-PYRIDINE MEDIUM. Koppiker, K. S.; Gajankush, K. B. (Atomic Energy Establishment, Trombay (India)). 1965. 17p. Dep. mn.

A method is described for the spectrophotometric determination of uranium in acetone medium using 8-hydroxyquinoline. Addition of a base like pyridine was found to reduce reagent blank and enhance color of uranium. Optimum concentrations of reagent and pyridine were found and the procedure was applied for the analysis of impure aqueous solutions and low grade ore samples. For the elimination of interference due to other ions, an ethyl acetate extraction of uranium from a solution nearly saturated with aluminum nitrate is recommended. The color is then developed using an aliquot of the ethyl acetate extract. (auth)

7000 (AERE-M-1483) A CHROMATOGRAPHIC METHOD FOR THE SEPARATION OF NITROSYLRUTHENIUM COMPLEXES IN ORGANIC SOLUTIONS AND ITS APPLICATION TO SOME PILOT-PLANT SOLUTIONS. Lyon, C. E. (Atomic Energy Research Establishment, Harwell (England)). Oct. 1964. 12p. Dep. mn.

A method for the separation of nitrosylruthenium complexes by reversed-phase paper chromatography was extended from aqueous phases to TBP phases, and applied to three solutions taken from a counter-current pilot plant run using 20% TBP. The ruthenium in the aqueous feed used in the run was found to be present almost entirely (95%) as nitrato complexes of nitrosylruthenium; in the scrub section certain complexes were entirely removed leaving in the organic product three complexes, two of which were identified as the trinitrato and tetranitrato complexes of nitrosylruthenium; the third was tentatively attributed to a complex containing dibutylphosphoric acid. (auth)

7001 (BNWL-SA-410) DETECTION OF OILS IN FUEL SUPPLIES. Anderson, H. J.; Skeie, Denis S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 14, 1965. Contract AT(45-1)-1830. 6p. (CONF-651119-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Libby Cockcroft Information Exchange Meeting, Harwell, Eng.

Methods are described for continuous extraction of UO_2–PuO_2 fuel materials and infrared analysis of the CCl_4 extracts. If normal precautions are taken during the extraction of the UO_2–PuO_2 fuel inside a glove box, radioactive contamination is low enough to permit the mounting of infrared samples in an open hood. The samples are then analyzed in a routine laboratory room with little extra care. Infrared analysis of concentrated CCl_4 extracts of PuO_2–UO_2 fuel mixtures was completed on an infrared spectrophotometer equipped with a NaCl prism. The oil concentration of the extracts was determined from the appropriate calibration curve and the contamination of the fuel calculated. (P.C.H.)

7002 (INR-609/XIX/D) STUDY ON REMOVAL OF SOME RADIONUCLIDES FROM SEWAGE WATER SOLUTIONS BY SORPTION ON PEAT. Kostyrko, A. (Institute of Nuclear Research, Warsaw (Poland)). Feb. 1965. 45p. Dep.

Studies were made on the interaction between peat moss and the following cations: Na^+, Ca^{2+}, Co^{2+}, Zn^{2+}, Sr^{2+}, Y^{3+}, Ru^{3+}, Cs^+, Ce^{3+}, Eu^{3+}, Tl^+, Hg^{2+}, and Pb^{2+}. Some comparative tests were performed also with humus-rich peat specimens, as well as with peat moss pretreated with 1N HCl. Peat moss was found to be hydraulically suitable as a column material. As was expected, distribution coefficients [K_d] for peat moss were less pH dependent than those for humus-rich peats. Total sorption characteristics [5-50 meq/100 g of peat] were distinguished from ion exchange capacities [5-40 meq/100 g of peat], and the order of selective affinity by peat for these nuclides was checked. (auth)

7003 (INR-634/V/C) ADSORPCJA JONOW Z ROZTWOROW WODNYCH NA POWIERZCHNI METALI I ICH TLENKOW. (Adsorption of Ions From Aqueous Solutions on Metal and Oxide Surfaces). Herczynska, Elwira (Institute of Nuclear Research, Warsaw (Poland)). May 1965. 116p. Dep. mn.

The adsorption of radioactive anions and cations was studied at the surface of noble and common metals and other materials, as a function of pH and the concentration of the aqueous solutions. From the results it was concluded that the adsorption of radioisotopes is an ion-exchange with the anions; the cations present in solutions on one hand, and the H^+ and OH^- ions, on the other hand. The H^+ and OH^- ions are the potential-determining ions at the surface of oxides and oxide-covered metals. Modified Langmuir isotherms were obeyed. (auth)

7004 (IS-T-42) AN EQUILIBRIUM STUDY OF THE CHLORIDE AND NITRATE SYSTEMS OF PRASEODYMIUM AND NEODYMIUM WITH TRIBUTYL PHOSPHATE AND ACID [Thesis]. Gray, James Arthur (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 54p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

An equilibrium study was made of the solvent extraction systems $Nd(NO_3)_3$–$Pr(NO_3)_3$–HNO_3–H_2O–TBP and $NdCl_3$–$PrCl_3$–HCl–H_2O–TBP. Comparison of a rigorous expression for the separation factor, with available data, indicated that for the nitrate system the increase in the separation factor with increasing concentration is caused by an activity coefficient term. It was found that a good separation factor correlation for the nitrate system is obtained when the separation factor, $\beta_{Nd/Pr}$, is plotted versus equivalents of nitrate per 1000 grams solvent in the organic phase. The separation factor for the nitrate system was found to be a function of the ratio of the two rare earths only at very high acid concentrations and at very high mole ratios of neodymium to praseodymium. The separation factors, $\beta_{Nd/Pr}$, for the chloride system were less than unity, and not ratio dependent, for all concentrations and acidities used. The fact that for the system $SmCl_3$–$NdCl_3$–HCl–H_2O–TBP the separation factor $\beta_{Sm/Nd}$, was greater than neodymium and praseodymium. (auth)

7005 (IS-T-51) SPECTROSCOPIC PROPERTIES AND ANALYTICAL APPLICATIONS OF INDUCTION-COUPLED PLASMAS [Thesis]. Wendt, Richard Harold (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 67p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The induction-coupled plasma is an electric discharge

which is maintained entirely by inductive coupling to a radio-frequency generator. A plasma generating device was designed in which two laminar flows of argon contain the discharge within an open-ended quartz tube. The resulting discharge is a stable, continuous, inert, and high-temperature plasma. An ultrasonic aerosol generator was adapted to allow the introduction of samples into the plasma in a continuous yet variable manner. The addition of aqueous aerosols to the plasma converts it into a spectral source which is shown to have many applications in analytical spectroscopy. A representative set of elements, especially those which have low sensitivities in combustion flames, were studied using the induction-coupled plasma. In emission spectroscopy, the plasma is more sensitive than flames for many elements, and is comparable in sensitivity in atomic absorption spectroscopy. Chemical interferences between elements, which commonly depress the intensity of emission and absorption in flames, are much less a problem in the plasma. Thus, quantitative analysis of solutions with various matrix elements was accomplished for a series of nickel–chromium solutions. The induction-coupled plasma combined with an ultrasonic aerosol generator is shown to be useful and versatile for emission and atomic absorption spectroscopy, both qualitatively and quantitatively. The solution of specific analytical problems is now simplified by the distinctive features of the discharge which are reported. (auth)

7006 (KN–65-140(R)) FAST NEUTRON ACTIVATION ANALYSIS FOR SILICON IN IRON. Wood, D. E.; Roper, N. J. (Kaman Nuclear, Colorado Springs, Colo.). Apr. 15, 1965. 39p.

A method for determining silicon in iron was developed for the range 0.5 to 10% by weight of silicon. Samples are bombarded with 14 Mev neutrons, and then counted for gamma rays characteristic of the iron and silicon reaction products. Three analytical methods are proposed, which involve counting the iron activation as an internal flux monitor. These methods can be made automatic for routine determinations on a large scale. Sketches of a proposed design for an automatic system are included. Analysis time is as short as 2 minutes with a precision (2σ) of $\pm 1\frac{1}{4}\%$ of the silicon content of the sample. (auth)

7007 (KN–65-186) FAST NEUTRON ACTIVATION ANALYSIS FOR NITROGEN IN GRAIN PRODUCTS. Wood, D. E. (Kaman Nuclear, Colorado Springs, Colo.). Aug. 1965. 33p.

A method was developed for analyzing the percentage by weight of nitrogen in grain products. Samples are bombarded with 14-Mev neutrons, then counted for gamma rays characteristic of the reaction. A description of the process is given including the procedure for removal of interfering reactions and conditions for optimizing the analysis. Analysis times may be as short as 4 minutes with a precision of ± 2% of the nitrogen in the sample. (auth)

7008 (NAA-SR-Memo–11495) EVALUATION OF THE COMBUSTION-THERMAL CONDUCTIVITY TECHNIQUE FOR THE DETERMINATION OF CARBON IN URANIUM CARBIDE (LECO 70 SECOND CARBON ANALYZER). Larsen, C. M.; Glass, D. N. (Atomics International, Canoga Park, Calif.). June 30, 1965. Contract AT(11-1)-Gen-8. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The determination of carbon in UC was accomplished by using a new commercial instrument, the Leco 70 Second Carbon Analyzer. The precision of the LCA, based upon the NBS 4i standard, is 0.015 wt. % carbon. Carbon determinations by the LCA are accurate. The precision of carbon determinations in cast and zone-refined UC material, is not significantly different than the precision of the NBS 4i standard (0.015 wt. % carbon). The cost per analysis by the LCA is approximately $\frac{1}{4}$ that of the standard gravimetric method. This cost can be further reduced, under certain circumstances, by taking single instead of duplicate carbon determinations per sample. (auth)

7009 (NLCO–960) A CRITICAL EVALUATION OF THE ABSORPTION AND FLUORESCENCE CORRECTIONS IN QUANTITATIVE MICROPROBE ANALYSIS. Colby, J. W.; Conley, D. K. (National Lead Co. of Ohio, Cincinnati). Aug. 23, 1965. Contract AT(30-1)-1156. 23p. (CONF-650952–1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 4th International Conference on X-Ray Optics and Microanalysis, Paris.

A set of Cr – Fe alloys was prepared, checked for homogeneity, and chemically analyzed. The alloys were then analyzed in the microprobes of two different labs using a variety of analytical conditions. The K radiation x-ray intensity ratios obtained in the two labs were compared (after correction for dead-time and background), the results were averaged, and all data were corrected for absorption and fluorescence by characteristic radiation using most of the more popular and practical techniques. Conclusions regarding the methods used are discussed. (P.C.H.)

7010 (NLCO–963) X-RAY SPECTROMETRIC DETERMINATION OF THORIUM IN AQUEOUS AND ORGANIC SOLUTIONS. Blank, G. R.; Dingeldein, W. H. (National Lead Co. of Ohio, Cincinnati). Sept. 1, 1965. Contract AT (30-1)-1156. 23p. (CONF-651029–1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 15th Annual National Lead Co. Analytical and Physical Testing Symposium, Hightstown, N. J.

X-ray spectrometric methods were used for the accurate determination of widely varying concentrations of thorium in aqueous and organic solutions. A slightly modified version of a previously developed method was used for analysis of aqueous solutions. Strontium was added as an internal standard. This analysis can be completed in approximately 40 minutes. Organic solutions were analyzed by a single method without the use of an added internal standard. Thorium concentrations in the range from 0.05 to 75 g/l were derived from the ratio of the Th Lα_1 intensity to the intensity of the adjacent spectral background. The organic method was successfully used to analyze solution mixture Solvesso-100 with: diamyl amylphosphonate; di-sec-butyl phenylphosphonate; and tributyl phosphate. An organic solution can be prepared and analyzed in 10 minutes. (auth)

7011 (NLCO–964) APPLICATION OF ATOMIC ABSORPTION TO THE DETERMINATION OF SOME ELEMENTAL IMPURITIES IN URANIUM-BASED SAMPLES AND MAGNESIUM METAL. Jursik, M. L.; Werdmann, J. F. (National Lead Co. of Ohio, Cincinnati). Sept. 8, 1965. Contract AT(30-1)-1156. 21p. (CONF-651029–3). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 15th Annual National Lead Co. Analytical and Physical Testing Symposium, Hightstown, N. J.

Atomic absorption spectrophotometry was applied to the determination of iron and nickel in uranium trioxide and magnesium in uranium metal. The technique is rapid and precise. Atomic absorption was also used to confirm cadmium values in magnesium that were obtained by emission spectroscopy. Iron in the range of 20 to 60 ppM, uranium basis, is extracted from a hydrochloric acid solution of uranium trioxide into methyl isobutyl ketone. The organic containing the iron is aspirated into the flame without separation from the aqueous layer. Nickel in uranium trioxide in the range of 3 to 20 ppm is determined by the direct aspiration of a hydrochloric acid-methyl alcohol solution of the sample. The concentration of uranium in the solution is 4%. Magnesium in the range of 40 to 200 ppM in reactor grade uranium metal is determined by the direct aspiration of a hydrochloric acid solution containing 2% uranium. Cadmium in cut-crown magnesium is determined in the range of 0.2 to 1.0 ppM. Cadmium is separated from the magnesium as the sulfide, redissolved in nitric and perchloric acids, and aspirated into an air-hydrogen flame. (auth)

7012 (NLCO–969) COMPARISON OF ANALYTICAL PROCEDURES FOR QUANTITATIVE MICROPROBE ANALYSIS. Colby, J. W. (National Lead Co. of Ohio, Cincinnati). Oct. 29, 1965. Contract AT(30-1)-1156. 26p. (CONF-651115–1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Eastern Analytical Symposium, New York.

Several well-known techniques for correcting raw microprobe data are discussed and are subjected to analytical testing. It was found that although most of the correction procedures work fairly well for some systems, they work poorly for others. However, by judiciously choosing analytical conditions, and by employing a correction procedure appropriate to the system being analyzed and the analytical conditions employed, good results can nearly always be obtained. (auth)

7013 (NP–15649) DISTRIBUTION OF URANIUM AND FLUORIDE IN SOME TWO-PHASE SOLVENT SYSTEMS [Thesis]. Waite, Brian Dale Anthony (Battersea Coll. of Tech., London (England)). May 1964. 184p. Dep. mn.

Submitted to London Univ., University Coll., England.

Studies were made of the extraction from aqueous solution of nitric and hydrofluoric acids, alone and in the presence of each other and, where relevant, of hydrochloric acid, into bis(2-ethylhexyl)phosphate, tri-n-butyl phosphate, and tri-n-octylamine. Also, similar studies were made of the extraction of uranium in the presence of hydrofluoric and nitric acids into the same acidic, neutral, and basic organic solvents. In all cases, the practical work has taken the form of equilibrium experiments made under carefully controlled conditions and analysis of the resulting aqueous and organic phases. The organic solvents were used either alone or as solutions in various inert diluents such as kerosene, benzene, or xylene and the aqueous solutions covered a very wide range of concentrations. From the results, deductions were made regarding the mechanisms of the extraction processes and the nature of the species taken up into the organic media. Equilibrium constants are given and, where sufficient data are available, stability constants were calculated. Uranium was extracted into tributyl phosphate in the presence of nitric or hydrochloric acids but not at all in the presence of hydrofluoric acid. Possible explanations are offered for this. 146 references are cited. (P.C.H.)

7014 (NP–15688) A FEASIBILITY STUDY OF THE METHOD OF NON-DESTRUCTIVE ASSAY OF ^{235}U AND ^{239}Pu IN IRRADIATED FUEL SLUG. (Atomic Energy Establishment, Trombay (India)). Sept. 1965. Contract 92/RB. 114p. Dep. mn.

A spectrometer was constructed using a 400-kv neutron source and a 200-cm^3 Pb assembly. The energy calibration and the slowing down properties both above and below 1 ev were investigated using capture gamma rays from resonance absorbers. Two samples of Pu weighing about 45 and 150 mg/cm^2 were used in a feasibility study of the method. It was seen that even with a thick sample and isotropic neutron distribution, it was possible to resolve the fission peak at 0.3 ev. By comparing the fission rate of Pu to that of ^{235}U present in the natural U, it was possible to estimate the number of Pu atoms within 20%. The accuracy in the estimation of Pu can be improved using better counting statistics. A method of estimating ^{235}U burnup and ^{239}Pu production in irradiated samples is outlined. As a result of the high γ field due to fission products, Pb of about 10 cms thickness must be interposed between the sample and detector. This will reduce the fission counting rate to background level. It was seen that the introduction of a gamma attenuator between detector and sample has no effect on the Pu estimation, thus verifying that the method can be used for irradiated samples. (W.L.G.)

7015 (ORNL-TM-1357) THE EFFECTS OF TRACE IMPURITIES OF MOISTURE, OXYGEN, HYDROGEN, NITROGEN AND CARBON DIOXIDE IN GLOVE BOX ATMOSPHERES ON THE ANALYSIS OF THE ALKALI METALS. Goldberg, Gerald (Oak Ridge National Lab., Tenn.). Dec. 10, 1965. Contract W-7405-eng-26. 11p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A survey was made on the effects of atmospheric impurities during the handling of the alkali metals. Discussion is presented on: reactions between these impurities and the alkali metals; effects of impurities on some analytical procedures; and various dry box techniques for the handling of the alkali metals. Also included are suggested maximum permissible levels for these impurities as well as a bibliography of 30 references to pertinent publications. (auth)

7016 (RFP–598) RECOVERY OF PLUTONIUM FROM GRAPHITE. Williams, A. K.; Pinamont, C. J. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Nov. 8, 1965. Contract AT(29-1)-1106. 24p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Several methods were investigated for recovering plutonium from graphite residues. These methods include ignition of graphite and recovery of the ash by dissolution, hydrochloric acid leach, fuming nitric acid leach, and nitric acid-fluoride leach. Of those investigated, the nitric acid-fluoride leach method was found to be the most efficient process for plutonium recovery. (auth)

7017 (RT/GEO(65)4) ESPERIENZE DI LISCIVIAZIONE PER PERCOLAZIONE SU MINERALI URANIFERI DELL'ALTIPIANO SILANO. (Percolation Leaching Experiments on Uraniferous Minerals of the Silano Plateau). Rinelli, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sept. 1965. 25p. Dep. mn.

Percolation leaching tests were performed on autunitic ores, for the purpose of determining a process that would yield the highest recovery with the shortest contact time. The results demonstrated the competitivity of the process with the classical methods of leaching under agitation, even for plants with output higher than 1,000 ton/day. (auth)

7018 (TID–22474) CRITICAL EVALUATION OF THE STATUS OF THE NEUTRON ACTIVATION METHOD FOR COAL ANALYSIS. Report No. 1. Gorin, E.; Yavorsky, P. M. (Consolidation Coal Co., Library, Pa. Research Div.). June 16, 1964. Contract AT(30-1)-2978. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Proposed instrumentation for continuous monitoring of Btu content of coal by neutron activation was evaluated for cost and precision. The system involves diversion of a small stream of coal to a slow moving conveyor belt. It was concluded that precision was not sufficient to warrant proceeding with an on site demonstration. (P.C.H.)

7019 (LA-tr-65-24) SEPARATION OF THE RARE EARTH ELEMENTS BY THE RELATIVE SOLUBILITY OF THEIR CARBONATES IN WATER SATURATED WITH CO_2 GAS. Trombe, F.; Caro, P. Translated for Los Alamos Scientific Lab., N. Mex., from Proc. Conf. Rare Earth Res., 5th, Ames, Iowa, 1965, 3: 87-98(1965). 10p. Dep. mn; JCL $1.10 fs, $0.80 mf.

Although carbonates of the rare earths and Y are not very soluble, the measurements performed indicate a great relative difference in the solubility between Y and the rare earths. The relative differences in solubility were exploited by means of metathetical reactions. This led to the easy separation of elements presenting, for example, two very insoluble hydroxides, but of very different relative solubility. This principle was applied to the separation of rare earths and Y by acting on the relative insolubility of their carbonates. However, the extraction yield was very small. A metathetical reaction of the type: $Y_2(CO_3)_3 + 2\ NdCl_3 \rightarrow Nd_2(CO_3)_3 + 2\ YCl_3$ permits a considerable increase in the amount of Y extracted from the mixture, by closely maintaining the proportions of the equilibrium of the individual solubility of the carbonates. The metathetical reaction is brought about by addition of a small amount of acid in the solution which dissolves part of the mixture. (P.C.H.)

7020 THE HANDLING OF DEUTERATED WATER AND SPECIFIC PROBLEMS OF DEUTERIUM ANALYSES. Chifu, Alexandru (Inst. of Atomic Physics, Cluj). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 574-610(1965). (In Rumanian).

Methods recommended for storing, handling, and analyzing deuterated water are reviewed. The precautions neces-

sary to avoid isotopic fractionation during handling are indicated. Heavy water must be prevented from coming in direct contact with air, from which it may absorb CO_2, water vapors, and salt impurities. Stainless steel containers are recommended for storage. The samples may be removed as needed through tubes provided with polyethylene stopcocks under a dry nitrogen atmosphere. In view of the equilibrium established in the $H_2O-HDO-D_2O$ system, care must be taken not to add any hydrogen-containing material during the purification of the heavy water; thus BaO must be used instead of $Ba(OH)_2$ during distillation. The analytical method used, whether mass spectrometry, emission spectroscopy, interferometry, or infrared absorption spectroscopy, must be chosen on the basis of the deuterium content of the water. Differences in the vapor pressure of H_2O and D_2O may cause errors. Densitometric measurements under proper safeguards yield good results. The preparation of international reference standards of deuterated water and hydrogen is described. (41 references). (TTT)

7021 MODIFICATIONS AND EXTENSIONS TO AN EXISTING SEQUENTIAL SCHEME FOR DETERMINING FALL-OUT NUCLIDES IN WATER. Wood, R.; Richards, L. A. (Lab. of the Government Chemist, London). Analyst, 90: 606-22(Oct. 1965).

Extensions and modifications to an existing sequential scheme for the radiochemical determination of fallout nuclides in drinking and rain water are described. This scheme makes possible the determination, in the same sample of ^{54}Mn, ^{91}Yt, ^{147}Pm, and ^{95}Zr activities along with the more commonly determined Ba, Cs, Ce, and Sr fallout nuclides. After evaporation of the sample to dryness, conventional precipitation and solvent-extraction procedures are used to separate the various radioactive species carried on known amounts of added carriers. Mean chemical recoveries of the added carriers ranged from 40% for zirconium to 70% for strontium. Taking a 100-liter sample of drinking water and using low-background anticoincidence-counting assemblies for detection of the β particles gave levels of detection ranging from 0.01 pC per liter for ^{147}Pm to 0.002 pC per liter for ^{90}Sr. The ^{54}Mn was determined by γ-counting with a limit of detection of 0.02 pC per liter. (auth)

7022 OPTICAL EMISSION SPECTROGRAPHIC DETERMINATION OF TANTALUM AND TUNGSTEN IN PLUTONIUM. Barton, H. N. (Dow Chemical Co., Golden, Colo.). Appl. Spectros., 19: 159-62(1965).

A spectrochemical method for the determination of 10 to 1000 ppm tantalum and 20 to 1000 ppm tungsten in plutonium metal is described. Chemical separation by precipitation of the plutonium as insoluble plutonium trifluoride, centrifuging, and sampling the supernatant solution is well suited to the glove box operation necessary in handling plutonium. Excitation is by graphite spark; spectra are recorded photographically. Concentrations are determined by standard photometry practices using an emulsion calibration-analytical curve technique with a molybdenum internal standard. (auth)

7023 EVIDENCE OF OXONIUM H_3O^+ IN SOME URANIUM COMPOUNDS OF THE TYPE $mXO.nUO_3.pH_2O$ CONFORMING TO THE HYPOTHESIS OF H. BRASSEUR. Peters, J.-M. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 34: 308-23(1965). (In French).

The hypothesis according to which in certain U compounds with the formula $\underline{m}XO.\underline{n}UO_3.pH_2O$ the water of crystallization is found in the ionic forms of oxonium H_3O^+ and hydroxide HO^- was verified on diuranates, triuranates, and billietites. Chemical and thermal gravimetric analyses as well as a radiocrystallographic study of these compounds treated with ammonia show exchange reactions which can only be explained by the hypothesis and the general formula of H. Brasseur, $X_m.U_2O_{6+m}.(H_3O)^+_{2-m}.(OH)^-_{2-m}$. (tr-auth)

7024 DETERMINATION OF ^{90}Sr AND ^{137}Cs IN RAIN WATERS. APPLICATION OF THE METHOD TO THE MEUSE WATER. Govaerts, J.; Guillaume, M.; Walch, N. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 34: 330-6 (1965). (In French).

The method used for collecting rain water and determining the concentration of ^{90}Sr and ^{137}Cs is described and discussed. Sr is precipitated in the form of sulfate, and Cs in the form of colbaltonitrate. The radiation measurements are made on samples in this form. The results obtained in measurements on Meuse water using the method are tabulated. (J.S.R.)

7025 APPLICATION OF DUMAS AND KJELDAHL METHODS TO THE DETERMINATION OF NITROGEN IN URANIUM NITRIDES. Takahashi, Yasuo (Inst. of Physical and Chemical Research, Tokyo). Bunseki Kagaku, 14: 939-45(Oct. 1965). (In Japanese).

Dumas and Kjeldahl procedures were applied to the determination of nitrogen in uranium nitrides. Uranium nitride was decomposed with or without an oxidizing agent between 600 and 900°C, and the volume of nitrogen evolved was measured. Good reproducibility was obtained by using Cu-oxide or decomposition product of $AgMnO_4$ as the oxidizing agent. Various acids and catalyzers were tested to digest uranium nitride by the Kjeldahl procedure, and a combination of H_2SO_4 with Se, which was added in the form of H_2SeO_4, $SeOCl_2$, or SeO_2, was found to be most effective to dissolve uranium nitride and convert its nitrogen to ammonia. The uranium nitride was composed of a body-centered-cubic U_2N_3 phase. The analytical results of the modified Kjeldahl procedure agreed well with those obtained by the modified Dumas procedure. For uranium nitride composed of the UN phase, however, the results obtained by the Kjeldahl were lower by about 5% than those obtained by the Dumas. It was concluded that Dumas procedure was preferred for routine determination of nitrogen in uranium nitrides. (auth)

7026 QUANTITATIVE DETERMINATION OF BORIC ACID IN ISOMERIZATION CATALYSTS USING THE NEUTRON-ABSORPTION METHOD. Russow, Rolf. Chem. Tech. (Leipzig), 17: 563-4(Sept. 1965). (In German).

A neutron-absorption method for the quantitative determination of boric acid in isomerization catalysts is described. The experimental devices used are described and the results are tabulated. The results showed that boron can be determined by the neutron-absorption method in other materials which contain no elements with a large capture cross section for thermal neutrons. (J.S.R.)

7027 PLUTONIUM, URANIUM, AND ZIRCONIUM EXTRACTION FROM SOLUTIONS CONTAINING COMPLEX-FORMING SUBSTANCES. II. SPECTROPHOTOMETRIC TIRON DETERMINATION. Zdrazil, K.; Havelka, S. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Collec. Czech. Chem. Commun., 30: 2855-8(Aug. 1965). (In German).

The conditions for spectrophotometric determination of tiron (the sodium salt of benzene-1,2-dihydroxy-3,5-disulfonic acid) were established. The extinction of the solution was measured at 289 mμ in 1$\underline{N}$ H_2SO_4 solution. The solutions obeyed the Lambert-Beer law up to concentrations of $5 \times 10^{-4}\underline{M}$ tiron. (tr-auth)

7028 MICRO DETERMINATION OF LANTHANUM(III) USING p-NITROBENZENE AZOCHROMOTROPIC ACID (CHROMOTROPE 2B) AS A CHROMOGENIC REAGENT. Sangal, Satendra P. (Univ. of Allahabad, India). J. Prakt. Chem., 25: 326-8(1964).

$\underline{p}$-Nitrobenzene azochromotropic acid can be used as a chromogenic reagent for Th, Cu, La, and the rare earths. The composition of lanthanum(III)-Chromotrope 2B chelate was found to be La(Chromotrope 2B) at pH 6.0. The stability constant, by two different methods, was 4.5 and 5.9. Spectrophotometric measurements of La(III) with Chromotrope 2B in micro amounts were made. Color formation was found to be instantaneous but the solutions were kept for 15 min before measurements for attaining equilibrium. The system adhered to Beer's law from 0.34 to 16.7 ppm of lanthanum. The following cations and anions interfered at all concentrations with color formation: Cu, Sc, V, rare earths, Ti, Zr, Hf, Th, phosphate, acetate, oxalate, tartrate, citrate, borate, and carbonate. The following

ions were found to be tolerated in large excess: sulfite, sulfate, thiosulfate, chloride, bromide, chlorate, bromate, Li, Na, K, Ca, Sr, Ba, Mg, Al, In, Sn(IV), Pb, Sb(III), As(III), Bi, Ag, Au, Zn, Cd, Hg, Fe(III), Co, Ni, Ru, Rh, Pd, and Pt. (BBB)

7029 THE APPLICATIONS OF X-RAY EXCITED OPTICAL FLUORESCENCE TO ANALYTICAL CHEMISTRY. Lineares, R. C.; Schroeder, J. B.; Hurlbut, L. A. (Perkin-Elmer Corp. Norwalk, Conn.). Spectrochim. Acta, 21, 1915-20(Nov. 1965).

Apparatus for measuring x-ray-excited optical emission spectra is described. A technique is described in quantitatively measuring the concentration of Tb, Dy, Eu, and Gd in Y_2O_3. The limits of detection were found to be 0.02, 0.03, 1.0 and 1.0 ppm, respectively. A method for substantially reducing these limits is given. The limits of detection for rare earth impurities in synthetic garnets and CeO_2 appeared to be comparable to that measured in Y_2O_3. (auth)

7030 THE MEASUREMENT OF DEUTERIUM IN WATER NEAR NATURAL CONCENTRATIONS USING A STANDARD INFRA-RED SPECTROMETER. Fydelor, P. J. (Royal Military Coll. of Sciences, Shrivenham, Eng.); Rawson, D. S. Spectrochim. Acta, 21: 1957-71(Nov. 1965).

A rapid method was envolved for the accurate determination of deuterium in water over the concentration range from 0.090 to 0.24% using a conventional infrared spectrometer. The temperature effect on the absorbance was studied and the evaluation of its magnitude led to careful control of the temperature of both the sample and reference cell. A precision of ±3.3% was obtained for a concentration range of 0.090 to 0.24 wt % D_2O. (auth)

7031 ON THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) IN THE PRESENCE OF FOREIGN ELEMENTS WITH THE HELP OF HALOGEN DERIVATIVES OF ACETIC ACID. Spacu, P.; Popea, Florica; Tohaneanu, Constanta (Forschungsstelle fuer Anorganische Chemie an der Akademie der S.R.R., Bucharest). Z. Anal. Chem., 214: 338-41(1965). (In German).

The buffer solutions $CH_2ClCOOH + CH_2ClCOONa$(I), $CH_2BrCOOH + CH_2BrCOONa$(II), and $CH_2ICOOH + CH_2ICOONa$(III) are shown to provide reagents for the spectrophotometric determination of uranium. The method can be used for the direct determination of 0.11903 to 2.85684 mg of uranium with 0.1M reagents, when Y^{3+}, Ce^{3+}, or Th^{4+} are present. With 1M concentrations, 0.11903 to 3.80912 mg of uranium could be directly determined in the presence of Y^{3+} and Ce^{3+}. With (I) or (II), thorium had no effect on the absorbance; with (III) uranium had to be previously extracted into ethyl acetate. (auth)

7032 THE USE OF XYLENOL ORANGE IN FLUORIDE VOLUMETRIC ANALYSIS WITH THORIUM NITRATE. Schmidt, J.; Ortloff, R. (DAMW Pruefstelle fuer Organisch-Technische Chemie, Altenburg, Ger.). Z. Chem., 6: 236(June 1965). (In German).

A procedure to determine the completeness of fluoride precipitation with Th, using xylenol orange, is described. A buffer composed of 6.7 g glycine, 11 ml 1N NaOH, and 11 g $NaClO_4$ brought to 100 ml with distilled water was used. The change of the xylenol orange was from yellow to purplish red; for qualitative improvement, several drops of aqueous Chicago blue solution were added. Under these conditions the change was from brilliant green to violet, and before the change a gray color was observed. Standardization of the Th solution was with KF. In addition to the determination of inorganic fluorides, the method is also suitable for the determination of organic substances after suitable decompositions. Decomposition of C−F compounds in nickel bombs and alkaline alcoholysis of P−F compounds gave results for 5 to 10 mg samples having errors ranging from −2.0% to 1.6%. (BBB)

7033 A DETERMINATION OF GOLD IN ROCKS AND METEORITES BY NEUTRON ACTIVATION. Perezhogin, G. A.; Alimarin, I. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim., 20: 793-8 (1965). (In Russian).

A method was developed for the determination of gold in rocks and meteorites by neutron activation using substoichiometric separation. Factors influencing the accuracy of the determination are considered. (auth)

7034 SPECTROPHOTOMETRIC STUDY OF THE INTERACTION OF SCANDIUM IONS WITH PYROCATECHOL VIOLET. Onosova, S. P.; Kuntsevich, G. K. (Ural Polytechnical Inst., Sverdlovsk, USSR). Zh. Anal. Khim., 20: 802-4(1965). (In Russian).

Scandium forms a blue compound with pyrocatechol violet at a molar ratio of 1:1 with anion nature. The maximum absorption is at 590 to 600 mμ. The molar extinction coefficient at λ = 590 mμ is $(1.73 \pm 0.13) \times 10^4$. The optimum conditions for color development are between pH 5.0 to 5.7 and a twofold excess of the reagent. Rare earths up to 100 μg in 25 ml do not interfere in scandium determination with pyrocatechol violet in the presence of an acetate buffer solution. (auth)

7035 A STUDY OF CERTAIN ORGANIC REAGENTS FOR NEPTUNIUM(V). Chudinov, E. G. Zh. Anal. Khim., 20: 805-11(1965). (In Russian).

The interaction between neptunium(V) and 12 organic reagents was studied spectrophotometrically. Neptunium(V) reacts with organic reagents in an alkaline medium (arsenazo(III) and chlorophosphonazo(III) are an exception) substituting one hydrogen atom in the organic molecule and forming a compound with a ratio of 1:1. It is shown that the best reagents for neptunium(V) determination are 1-(2-pyridylazo)-resorcinol, arsenazo(III), and chlorophosphonazo(III). (auth)

7036 DIRECT DETERMINATION OF URANIUM IN ORGANIC SOLVENTS. Bakos, L.; Andras, L. (Central Research Inst. for Physics, Budapest). Zh. Anal. Khim., 20: 820-3(1965). (In Russian).

It is shown that uranium can be determined in extracts by means of the Sakharov method. In solutions of di-2-ethylhexyl phosphate, tri-n-butyl phosphate, tri-n-octylamine, and tri-n-octylphosphine oxide the equivalence point can be established within the range of 1.1×10^{-1} to 3×10^{-5}M of uranium in most cases with an accuracy of ±5.0%. (auth)

7037 PHOTOMETRIC DETERMINATION OF SCANDIUM WITH STILBAZOCHROM. Alykov, N. M.; Cherkesov, A. I. (Saratov State Pedagogical Inst., USSR). Zh. Anal. Khim., 20: 870-1(1965). (In Russian).

Stilbazochrom (stilbene−2,2′-disulfonic acid-4,4′-bis-[(azo-2″)-1,8-dihydroxynaphthalene-3,6-disulfonic acid]) was suggested as a reagent for the photometric determination of scandium. The sensitivity of the reaction was 10^{-2} μg/ml. The methods were tested on a sample of scandium-containing mineral and on an artificial mixture. The relative experimental error was not more than 5%. (auth)

7038 METHODS OF ANALYSIS OF CONDENSED SYSTEMS USING THE NEUTRON SPECTROMETER. Caglioti, Giuseppe (Euratom, Ispra, Italy). pp 121-32 of Fisica dello Stato Solido. Convegno Indetto dalla Societa Lombarda di Fisica, Pavia, 16–18 Luglio 1962. Rome, Consiglio Nazionale delle Ricerche, 1964. (In Italian). (RT/FI(65) 10).

Some applications of slow-neutron spectrometry in the field of the physics of condensed systems are discussed. The nature of the information that can be obtained with this method is examined and it is shown how diffraction experiments can give information on the structure or static configuration of solids and liquids. Elastic scattering experiments can lead to a description on a microscopic scale of the dynamic behavior of the material system. Some of the currently used experimental procedures are illustrated by examples. The principal advantages and limitations of neutron spectrometry for this purpose are discussed. (tr-auth)

7039 THE DETERMINATION OF TITANIUM, ZIRCONIUM, AND HAFNIUM IN MOLYBDENUM, NIOBIUM AND TANTALUM ALLOYS BY ION EXCHANGE [Thesis]. Shakashiro, Mouaffac Hamdy. Corvallis, Ore., Oregan State Univ., 1965. 117p.

The anion exchange behavior of titanium, zirconium, hafnium, molybdenum, tantalum, and niobium in the aqueous and mixed solvent sulfuric-oxalic acid system was studied. The distribution coefficient concept and the plate theory were utilized to find the proper conditions of separation. The effect of oxalic acid concentration, sulfuric acid percentage, and methanol percentage on the elution character of the six metal ions was investigated. It was found that greater adsorption is favored at low percentage of sulfuric acid and high concentration of oxalic acid. In the presence of both acids, methanol decreases the adsorption of molybdenum, titanium, tantalum, and niobium, and increases the adsorption of zirconium and hafnium. As a result, 17 separation procedures, involving different combinations of the six metals investigated, were developed using the concept of the minimum height column. These procedures were tested on synthetic metal mixtures and found adequate. As low as 0.05% titanium and 0.05% zirconium could be separated from a molybdenum base alloy and determined accurately. Large amounts of constituents can be separated and determined as well. It was also found that titanium does not form anionic complexes in the presence of sulfuric acid and needs a high level of sulfate ion to form such complexes. Zirconium sulfate complexes are more stable than hafnium complexes. Molybdenum forms sulfato complexes that seem to be in slow equilibrium with some unadsorbable species. All six metal oxalato complexes are stable at low hydrogen ion concentration. At high acidities these complexes break down. Methanol tends to increase the adsorption of metal ions from strong acid solutions. In the presence of oxalic acid, however, the adsorption decreases. (Dissertation Abstr.)

7040 INVERSE ISOTOPE DILUTION FOR THE ASSAY OF THIAMINE HYDROCHLORIDE [Thesis]. **Harris, Wayne Garry. Lafayette, Ind., Purdue Univ., 1965. 75p.**

Thiamine hydrochloride was cleaved with sodium sulfite-S-35 in an acidic medium to yield a labeled pyrimidine sulfonic acid derivative. This cleavage provided the basis for an inverse isotope dilution assay for thiamine hydrochloride. By dilution of the labeled derivative with nonradioactive carrier and determination of the specific activity of the carrier-diluted derivative, the amount of thiamine hydrochloride originally present in a sample was calculated. The specific activity of the sodium sulfite-S-35 was determined by performing inverse isotope dilution on a known amount of reference standard thiamine hydrochloride. A direct isotope dilution procedure was utilized to prove that the cleavage of thiamine by sodium sulfite was quantitative. The accuracy and precision of the assay were studied with pure thiamine hydrochloride in a range from 100 to 10 mg. Pharmaceutical preparations containing thiamine hydrochloride in quantities from 5 to 100 mg were assayed. It was shown that, regardless of the ingredients in these preparations, the inverse isotope dilution method can be applied with a high degree of precision and accuracy. (Dissertation Abstr.)

7041 AN INVESTIGATION OF COPPER AND OTHER SELECTED ELEMENTS IN SOILS UTILIZING GAMMA RADIATIONS INDUCED BY THERMAL NEUTRON ACTIVATION [Thesis]. **Kline, Jerry Robert. Minneapolis, Univ. of Minnesota, 1964. 199p.**

The applicability of neutron activation to soils analysis was studied under a three-phase plan: (1) observation of dose rates of neutron-activated soils and the adaptation of chemical and spectrometric techniques to soils analysis; (2) qualitative and quantitative observations of activated soils by gamma-ray spectrometry to identify and measure the dominant gamma-emitting isotopes; and (3) a detailed study of copper distribution and reactions in soils utilizing the 12.8-hour isotope copper-64. The dose rates of activated soils were in the range of 17–50 R/hour after irradiation for 5 minutes at a thermal flux of 2×10^{13} n/cm^2/sec. Decay was rapid and dose rates of 0.1–0.2 R/hour were found after 16 hours. Observation of gamma spectra of activated soil led to the identification of scandium-46, lanthanum-140, iron-59, chromium-51, cobalt-60, and cesium-134. These isotopes with the exception of cesium-134 were measured quantitatively by instrumental methods with no chemical processing. Isotopes whose half lives were shorter than 14.97-hour sodium-24 could not be observed by instrumental methods since the spectra were dominated by gamma rays from this isotope. The gamma-ray spectra of the longer lived isotopes in soils were not distinctive from one sample to the next and could not be used to identify or classify soils. Copper in 6 surface and subsurface soils was fractionated by chemical methods after neutron irradiation. The first fraction was obtained by self-diffusion wherein samples were extracted with dilute solutions of $CuSO_4$. After removal of the diffusible fraction, the soils were extracted in hot solutions of dilute $CuSO_4$ 0.1M in HCl. Residual copper was determined after removal of the first 2 fractions by dissolution of the soil in HF, $HClO_4$, H_2SO_4 mixtures. Neither plant growth nor copper uptake by plants was related to the amounts of copper found in any of the soil fractions. Data was obtained indicating that soils could release copper at faster rates than were required by plants and that plant uptake not released from soil was the rate limiting step. (Dissertation Abstr.)

7042 THE NON-DESTRUCTIVE EXAMINATION OF IRRADIATED NUCLEAR FUEL FOR BURN UP BY GAMMA SPECTROMETRY WITH MECHANICAL SCANNING. **Fudge, A. J.; Foster, E.; Murphy, L. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-67/50, 11p. (CONF-650803-20). ORINS.**

From IAEA Symposium on Nuclear Materials Management, Vienna.

Gamma spectrometry with mechanical scanning of irradiated nuclear fuel was used for nondestructive determination of the absolute burnup and the distribution and total burnup for a fuel assembly. Information on the state of the fuel, on the movement of fuel within the cladding, and on detailed neutron flux distribution within the reactor is also obtained. Fully automatic equipment was designed and operated to enable the distribution of specific radioactive fission product nuclides to be determined for both rod and plate type fuel assemblies. Physical resolution and gamma attenuation was achieved by variable collimation, filtration, and distance. Electronic detection and resolution was obtained using sodium iodide crystals and solid state detectors followed by pulse height analysis. Profile recording of the intensity was carried out by analog and digital measurement, and an X-Y-Z plotter. Mechanical scanning of the fuel element was carried out at either a continuous uniform speed or in a series of equal increments equal to the collimator slit width. A high degree of reproducibility could be achieved for both systems and corresponding recording equipment by electronic pulse circuitry control. Two-dimensional scanning was used for plate specimens. Automatic control was maintained from a programmed input and ensured continuous operation. The precision and accuracy of this technique of burnup determination is discussed in relationship to fissile material distribution and the calibration technique employed. (auth)

7043 A MULTI-SCALER RECORDING SYSTEM AND ITS APPLICATION TO RADIOMETRIC OFF-LINE ANALYSIS. **Bisby, H.; Richards, J. M. (Atomic Energy Research Establishment, Harwell, Eng.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-67/49, 13p. (CONF-650803-11). ORINS.**

From IAEA Symposium on Nuclear Materials Management, Vienna.

Techniques and instrumentation for the precise analysis of representative samples taken from the process streams are discussed. These techniques, in particular those involving pulse counting systems, can be made automatic with instrumentation in which the data are obtained in digital form in electronic stores (scalers). The automatic recording system described provides a common data read-out facility for more than 50 independently operating counting systems, recording scaler data, together with associated sample and system identification and the absolute time occurrence of each read-out. The data can be

recorded, in forms suitable for subsequent processing by a computer, on a variety of tape and card punches. serial and parallel printers or magnetic tape. In addition, the whole recording system, including the scalers in any one system, can be checked for correct operation on an automatic routine basis, which does not interfere with the operation of other counting systems. (auth)

7044 URANIUM ORE AND CONCENTRATE SAMPLING. McGinley, F. E.; Brown, D. L.; Langridge, R. W. (Atomic Energy Commission, Grand Junction, Colo.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-67/30, 20p. (CONF-650803-34). ORINS.

From IAEA Symposium on Nuclear Materials Management, Vienna.

Each step in the overall measurement and sampling systems for both ores and concentrates is discussed, with particular attention paid to the accuracy and precision of that step. The ordinary principles of ore sampling, as used for years in the mining industry, were followed. However, sufficient check sampling and other tests were performed to assure that the uranium content of the variety of ores sampled was as accurately determined as economically feasible. Concentrates containing about 129,000 tons of U_3O_8 were purchased during the last 17 years. This uranium was contained in approximately 10,000 lots, each of which was weighed, sampled, and analyzed in accordance with carefully controlled procedures. The average lot consisted of about 50 drums (55-gallon size) and weighed approximately 35,000 pounds. Because concentrate varied so much in both physical and chemical characteristics, it was necessary to sample each drum. Through the years, various sampling systems were used, such as pipes, open auger, enclosed augers, and falling stream sampling. Falling stream sampling was found to be the most accurate, provided precautions are taken to prevent changes in weight due to exposure to the atmosphere. Because of the tendency of concentrates to adsorb or lose moisture, depending upon the atmosphere to which they are exposed, special subsampling, drying, and sample preparation procedures were continuously developed to improve the accuracy and precision of the overall purchase sampling. Extensive use was made of statistics to analyze and interpret measurement and sampling evaluation data. (auth)

7045 X-RAY OPTICS AND X-RAY MICROANALYSIS. Third International Symposium, Stanford University, Stanford, California, August, 1962. Pattee, H. H.; Cosslett, V. E.; Engstroem, Arne (eds.). New York, Academic Press, 1963. 639p. (CONF-620803).

Fifty-two papers prepared for the International Symposium on X-Ray Optics and X-Ray Microanalysis, Stanford, California, August 22 to 24, 1962, are presented. Instrumentation and applications are discussed. (M.C.G.)

7046 SOME TRACE ELEMENT DETERMINATIONS OF POTENTIAL APPLICATION TO BIOLOGICAL MATERIALS. Smales, A. A.; Mapper, D. (Atomic Energy Research Establishment, Harwell, Eng.). 15p. (CONF-384-3). ORINS.

From Symposium on Radioactivation Analysis and Its Application to the Biological Sciences, Saclay, France, Sept. 1963.

Procedures are described for the determination of trace amounts of As, Sb, Cr, Cu, Ce, In, Mo, Pd, Ag, and Zn after neutron activation. Emphasis is placed on procedures for radiochemical separation and purification of the elements. The procedure is applicable to biological materials. (C.H.)

Inorganic and Physical Chemistry

Refer also to abstract 7220.

7047 (ANL-7086) THE EFFECT OF INTERPARTICLE FORCES ON THE FLUIDIZATION OF FINE PARTICLES. Baerns, Manfred G. (Argonne National Lab., Ill.). Aug. 1965. Contract W-31-109-eng-38. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The effects of interparticle forces on the feasibility of gaseous fluidization of particles in the size range of less than 50 μ was investigated. Both the onset and quality of fluidization were determined by measurements of pressure drop across the bed and by measurements of heat transfer between the bed and a heated plate immersed in the bed. The interparticle adhesive forces and friction coefficients were measured by the inclined-plane method. The ratio of the incipient fluidization velocity calculated by a conventional relationship without accounting for interparticle forces, and the incipient fluidization velocity determined by the pressure-drop and heat transfer-measurements was used as an index, F.I., describing the fluidizability of a particulate material. The results indicate that F.I. depends mainly on the interparticle adhesive force. The limitations of the feasibility of fluidization were found to depend on the ratio of the weight of a particle to its adhesive force; no fluidization could be obtained when this ratio was less than 10^{-3}. (auth)

7048 (IS-T-30) THE SYNTHESIS OF REDUCED HAFNIUM IODIDES [Thesis]. Struss, Arthur William (Ames Lab., Iowa State Univ. of Science and Tech.). July 1965. Contract W-7405-eng-82. 30p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Pure HfI_3 was prepared by the reduction of HfI_4 with hafnium metal foil at 500° and subsequent isolation of the pure product by scraping the HfI_3 layer from the hafnium foil. High-temperature equilibrations and disproportionation studies of HfI_3 demonstrated that HfI_3 is the only reduced hafnium iodide, and HfI_2 is non-existent. (auth)

7049 (IS-T-50) VAPOR PRESSURES OF ALKALINE EARTH BROMIDES AND IODIDES [Thesis]. Hutchison, John Francis (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 37p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Vapor pressures of the bromides and iodides of calcium, strontium, and barium were measured as a function of temperature. An equation for the vapor pressure of each halide was obtained by a least squares treatment of the data. These are presented along with the calculated normal boiling points and enthalpies of vaporization. Supporting work includes the preparation and purification of these halides and the determination of their melting points. (auth)

7050 (KFK-341) UEBER POLYNAERE OXIDE DES VIER- UND SIEBENWERTIGEN TECHNETIUMS MIT ERDALKALIEN. (On Polyoxides of Four and Seven Valent Technetium with Alkaline Earths). Wassilopulos, Miltiades (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). July 1965. 67p. Dep. mn.

The ternary and quarternary oxides of four- and seven-valent technetium were investigated. Chemical and x-ray methods were used for the identification and characterization of the individual compounds of definite composition. $Ba(TcO_4)_2$, $Ba_3(TcO_5)_2$, and $Ba_5(TcO_6)_2$ were found in the $BaO-Tc_2O_7$ system. The following compounds were found in the $SrO-Tc_2O_7$ system: $(\alpha + \beta) - Sr(TcO_4)_2$, $Sr(TcO_4)_2 \cdot H_2O$, $Sr(TcO_4)_2 \cdot 2H_2O$, $Sr_3(TcO_5)_2$, and $Sr_5(TcO_6)_2$. $Ca(TcO_4)_2 \cdot 2H_2O$ was obtained by evaporation from aqueous solutions of the $CaO-Tc_2O_7$ system. In the systems $MeO-Me_2O-Tc_2O_7$ (Me = Ba, Sr, and Ca; Me = Li and Na), the compounds Ba_2LiTcO_6, Ba_2NaTcO_6, Sr_2LiTcO_6, and Sr_2NaTcO_6 were prepared by solid body reactions of $MeTcO_4$ and Me(II)O. In the $BaO-TcO_2$ system, both the compounds $BaTcO_3$ and Ba_2TcO_4 could be detected. $SrTcO_3$ and Sr_2TcO_4 were obtained by solid body reactions in the $SrO-TcO_2$ system. Only $CaTcO_3$ could be prepared by solid-state reactions from the $CaO-TcO_2$ system. $Ba_3Tc_2O_9$ was obtained by a symproportionation reaction in the $BaO-TcO_3$ system. The ternary and quarternary oxides of Tc, whose structures are known, are tabulated. (J.S.R.)

7051 (NP-15643) BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS. Brewer, L. (comp.) (California Univ., Berkeley). Sept. 30, 1965. 20p. Bureau of Standards Free.

References (177) on spectroscopy in high temperature

chemistry and reactions between gases and condensed phases are given to journals and reports published from 1962 to late 1965. (P.C.H.)

7052 (ORNL-TM-1340) THERMODYNAMIC CALCULATIONS RELATING TO CHLORIDE VOLATILITY PROCESSING OF NUCLEAR FUELS. IV. THE GAS-PHASE REDUCTION OF URANIUM PENTACHLORIDE AND HEXACHLORIDE TO SOLID TETRACHLORIDE WITH CARBON MONOXIDE. Gens, T. A. (Oak Ridge National Lab., Tenn.). Oct. 14, 1965. Contract W-7405-eng-26. 22p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The equilibrium yields of solid uranium tetrachloride from the reduction of gaseous uranium pentachloride and hexachloride were calculated from literature free energy data as a function of temperature and the amounts of carbon monoxide, chlorine, and inert gases present. At temperatures as low as 470°K, the calculated yields were greater than 99% if more than 10 moles of carbon monoxide and less than 5 moles of chlorine were introduced with 2 moles of uranium pentachloride and 1 mole of uranium hexachloride. The yields decrease rapidly with increasing temperature. These calculations show that the proposed reduction process is thermodynamically feasible. A process proposal is briefly outlined. (auth)

7053 (RFP-629) FORTRAN II PROGRAM FOR REDUCTION OF SPECTROPHOTOMETRIC REACTION KINETICS DATA. Werkema, G. J. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Nov. 17, 1965. Contract AT(29-1)-1106. 23p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A computer program, ERLF, is described that computes first-, second-, and third-order reaction rate constants by reduction of spectrophotometric absorbancy data using the respective integrated rate laws. The computer output tabulates the computed rate constants (k_1, k_2, and k_3), their time products (k_1t, k_2t, and k_3t), and the number of gram-molecular-weights of starting material that have reacted, as a function of time. (auth)

7054 (SC-RR-65-629) A KINETIC STUDY OF THE CHANGE IN THE ABSORPTION SPECTRUM OF URANIUM (IV) SOLUTIONS, WITH TIME, AT LOW ACIDITIES. Wear, J. O. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1965. Contract AT(29-1)-789. 13p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The slow decrease in the uranium(IV) absorption spectrum with time was studied as a kinetic process. The change was found to be due to hydrolysis of U^{4+} and to obey the rate equation: $-d[U^{4+}]/dt = k_1(1 + K/[H^+])[U^{4+}]$, where K is the hydrolysis equilibrium constant. The value of k_1 at 25°C and with $\mu = 1.0$ is 2.39×10^{-3} min^{-1}. The activation energy was found to be 5.51 kcal/mole. (auth)

7055 (UCRL-16436) ISOMERIC CHEMICAL SHIFTS AND ELECTRONEGATIVITY [Thesis]. Keller, David A. (Lawrence Radiation Lab., Univ. of California, Berkeley). Oct. 1965. Contract W-7405-eng-48. 33p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Mössbauer experiments were carried out at 4.2°K using ^{197}Au and ^{119}Sn as solutes in dilute binary alloys to study the relationship, if any, between the isomeric chemical shift and the difference in electronegativity between the solvent metal and the Mössbauer element. ^{197}Au was embedded into nineteen host lattices and the resulting isomeric chemical shifts of the Mössbauer resonance did show a positive correlation between the chemical shift and electronegativity. However, similar experiments using ^{119}Sn as the Mössbauer solute in six metallic lattices failed to show any correlation at all between chemical shift and electronegativity. (auth)

7056 CRYSTAL DATA FOR SCANDIUM MOLYBDATE, $Sc_2(MoO_4)_3$. Biedl, A. W. (Harvard Univ., Cambridge, Mass.). Acta Crystallogr., 19: 1059(Dec. 10, 1965).

Scandium molybdate single crystals were grown in lithium molybdate melts by cooling from 1150 to 750°C. The crystals are pseudotetragonal platelets. The density was determined to be 3.08 g cm^{-3} using the Berman microbalance. X-ray fluorescence analysis showed molybdenum and scandium only. The following lattice constants were found: a = 9.66, b = 9.56, and c = 13.25 Å, all ± 0.03 Å as compared with the lattice constants, a = 9.64 ± 0.005, b = 9.550 ± 0.004, and c = 13.246 ± 0.005 Å, calculated on the IBM-7094. Powder photographic data on $Sc_2(MoO_4)_3$ are given. (F.J.H.)

7057 EXAMINATION OF MASS-RADIUS EFFECTS, HYDROGEN BONDING AND ν_b SPLITTING IN INFRARED SPECTRA OF Zr–Hf HOMOLOGS. Adler, Hans H. (U. S. Atomic Energy Commission, Washington, D. C.). Amer. Mineral., 50: 1553-62(Oct. 1965).

Infrared absorption spectra of homologous hafnium and zirconium sulfate tetrahydrates refuted the idea that vibrational frequencies of functional molecules in crystals are affected by the mass of the external cation. The frequency shift of the SO_4^{2-} stretching modes was evidently caused by a slight change in ionic radius produced by cation substitution. The OH frequencies indicated hydrogen-bond formation. The shift of the O–H ... O stretching mode frequency reflected a decrease in the H-bonded oxygen–oxygen distance, thus evidently conforming to the change in cation size. The apparent splitting of the O–H ... O bending mode may be explained as arising from resolution of a degeneracy of the ν_2 fundamental of an unsymmetrical linear O–H ... O group. This interpretation requires abandonment of the conventional concept of proton-oxygen vibrations based on the bent H_2O model. The data indicated that cation substitution in isomorphous mineral systems may be expected to affect the strength of the H bond. The relation is generally one of increasing H-bond energy with decreasing cation size. (auth)

7058 THE ELECTRONIC STRUCTURE AND POSITION OF THE ELEMENTS IN THE PERIODIC TABLE. Villar, G. E. (Facultad de Ingenieria y Agrimensura, Montevideo, Uruguay). Bol. Fac. Ing. Agri-Mens. Montevideo, 8: 493-510(Dec. 1964). (In Spanish).

A modification of the periodic table is defended in which the positions of the lanthanides and actinides are altered slightly. In this reorganization the III B group consists of Sc, Y, Lu, and Lw, and a new position in the extended form of the periodic chart is opened to fit the actinides between Ba and Lu, and the lanthanides between Ra and Lw. Because of the organization of the chart which is applied, Lu and Lw should not be considered as the last members of the series completing the 4f and 5f shells, but rather the first of the series beginning the filling of the 5d and 6d shells. Application of experimental data to support these revisions is suggested, particularly the structure of ionized lanthanides from the emission spectra of La and Ac. (BBB)

7059 INVESTIGATIONS ON THE PEROXIDE COMPOUNDS OF URANIUM. I. PERORTHO-URANATE $(UO_5.3O)^{4-}$ AND DEGRADATION PRODUCTS. Martin-Frere, Henri (Univ., Paris). Bull. Soc. Chim. France, No. 10, 2860-8(Oct. 1965). (In French).

The acid degradation of the red perortho-uranate $(UO_5 \cdot 3\underline{O})^{4-}$ leads to the yellow perpyro-uranate $(U_2O_7 \cdot 3\underline{O})^{2-}$. Two processes take place simultaneously, one of which leads to the formation of the perortho-uranate acid $(HUO_5 \cdot 3\underline{O})^{3-}$. The equilibrium constants between these ions were calculated. The ion $(U_2O_7 \cdot 3\underline{O})^{2-}$ loses easily one active oxygen atom to give $(U_2O_7 \cdot 2\underline{O})^{2-}$ with analogous properties but in which the peroxide oxygen is very stable. (The active oxygen atoms are represented in the chemical-formulas by the symbol $\underline{O}$.) (tr-auth)

7060 INVESTIGATIONS ON THE PEROXIDE COMPOUNDS OF URANIUM. II. DISSOLUTION OF THE URANIUM PEROXIDE UO_4 IN ALKALINE HYDROXIDES. Martin-Frere, Henri (Univ., Paris). Bull. Soc. Chim. France, No. 10, 2868-74(Oct. 1965). (In French).

In concentrated alkaline solutions uranium peroxide forms two peruranates with one active oxygen per at.-g U: one was a yellow insoluble substance $M_2(U_2O_7 \cdot 2\underline{O})$, which was determined by the residual method, and the other was a red soluble compound $M_4(UO_5\underline{O})$. For this latter compound the number of active oxygen atoms was determined by spectrophotometric titration in 1$\underline{M}$ lithium oxide media. Solubil-

ity measurements and equilibrium studies with the $(UO_5 \cdot 3\underline{O})^{4-}$ made it possible to determine the valence of the ion and its monomeric character. (The active oxygen atoms are represented in the chemical formulas by the symbol $\underline{O}$.) (tr-auth)

7061 INVESTIGATIONS ON THE PEROXIDE COMPOUNDS OF URANIUM. III. FORMATION OF A COMPLEX URANIUM PEROXIDE IN THE PRESENCE OF ALKALINE CARBONATES. PERURANYLCARBONATE. Souchay, Pierre; Martin-Frere, Henri (Univ., Paris). Bull. Soc. Chim. France, No. 10, 2874-81(Oct. 1965). (In French).

Peruranates were formed when a uranyl salt was treated by hydrogen peroxide in an alkaline medium that was a base or alkaline carbonate. In the presence of an alkaline carbonate, the peruranylcarbonic ion with the formula $(UO_3\underline{O}(CO_3)_2)^{4-}$ also appeared. The conditions for the formation of this ion were very similar to those for the formation of the peruranates. A large excess of alkaline carbonate made it possible to study the uranyl tricarbonate ion in equilibrium. The equilibrium constant of $(UO_2(CO_3)_3)^{4-} + H_2O_2 + 2\ OH \rightleftharpoons (UO_3\underline{O}(CO_3)_2)^{4-} + CO_3^{2-} + 2\ H_2O$ was determined. (The active oxygen atoms are represented in the chemical formulas by the symbol $\underline{O}$.) (tr-auth)

7062 STUDIES ON THE TIME EVOLUTION OF EXCITATION OF SOME Ce, La, V, Ag, AND Cu SPECTRAL LINES BY THE METHOD OF TIME-RESOLVED SPECTROSCOPY. Boboli, Karol; Czakow, Julian (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 10: 595-602 (1965). (In Polish).

The time evolution of some spectral lines of Ce, La, V, Ag, and Cu was studied by the method of time-resolved spectroscopy. Oxides of Ce, La, V, and Ag, mixed with graphite, were pelleted. Electrodes were made of copper. As an excitation source an interrupted d-c arc was used. The duration of one arc pulse for La, V, Cu, and for Ce was, respectively, 4.2 or 4.5 m sec. The apparatus is described and results are discussed. (auth)

7063 COMPLEXES OF URANYL WITH PHENOLIC LIGANDS. I. POTENTIOMETRIC INVESTIGATION OF THE PYROGALLOL COMPLEXES. Bartusek, M. (Purkyne-Univ., Brno). Collect. Czech. Chem. Commun., 30: 2746-55(Aug. 1965). (In German).

In the potentiometric investigation of complex formations in approximately $10^{-3}\underline{M}$ uranyl salt solutions with pyrogallol excess, the complexes M_2R^+, MR^-, and $MR(RH_2)^{2-}$ were detected and the slightly soluble pyridine salt PyH(MR) was isolated. A method for the investigation of the system with different protonizing multinuclear complexes was worked out. (tr-auth)

7064 PREPARATION AND STUDY OF DOUBLE SODIUM AND RARE EARTH MOLYBDATE MONOCRYSTALS WITH RESPECT TO THEIR UTILIZATION AS LASER MATERIAL. Heindl, Rudolf; Damay, Francoise; Der Agobian, Roger; Loriers, Jean. Compt. Rend., 261: 3335-8(Oct. 27, 1965). (In French).

The method of preparation of monocrystals of double molybdates $NaLn(MoO_4)_2$ (where Ln designates one of the rare earth elements) and in particular of double molybdates of sodium and lanthanum doped with Pr, Nd, or Tb is described. After preparation of the simple molybdates by fritting, the double molybdates are obtained by crystallization in a flux and utilized for the synthesis of monocrystals by the Czochralski method. Some properties of the monocrystals thus obtained (melting point, densities, crystalline parameters of the quadratic cell, and spectra of absorption of fluorescence) are given. The monocrystals doped with Nd have been used with success to obtain the laser effect. (tr-auth)

7065 SYNTHESIS AND CRYSTALLOGRAPHIC DATA OF A DOUBLE OXIDE OF TANTALUM AND URANIUM. Gasperin, Madeleine (Laboratoire de Mineralogie-Cristallographie, Paris). Compt. Rend., 261: 3417-19 (Oct. 27, 1965). (In French).

Synthesis studies permitted the preparation of monocrystals of a double oxide of tantalum and uranium with a probable formula UTa_3O_{10}. It has been known up to now only in the microcrystalline state. The crystal is described, and its crystallographic data are reported. (tr-auth)

7066 SHAPES OF CRYSTAL GROWTH AND CRYSTAL STRUCTURE OF $YCl(OH)_2$. Klevtsova, R. F.; Klevtsov, P. V. (USSR Academy of Sciences, Siberia). Dokl. Akad. Nauk SSR, 162: 1049-52(June 11, 1965). (In Russian).

Crystalline yttrium hydroxychloride $YCl(OH)_2$ was obtained during the hydrothermal synthesis of crystals of yttrium ferrous garnet. The monocrystals were laminar in shape and extended in one direction. Sometimes the crystals were needle-shaped. The $YCl(OH)_2$ belongs to the class (2/m)(2/m)(2/m) = mmm (rhombodipyrimidal class). The pinacoid faces were the best developed. The parameters of the elementary cell were found to be: a = 6.21, b = 12.56, and c = 3.62 A (hence, a:b:c = 0.494:1:0.288). With a density of 3.71 g/cm^3 there are four formula units in the elementary cell. The relative locations of the Y, Cl, $(OH)_I$, and $(OH)_{II}$ groups were determined. (TTT)

7067 TRANSFER PROCESSES IN PARTICLE SYSTEMS WITH INTERNAL DEGREES OF FREEDOM. Zubarev, D. N. Dokl. Akad. Nauk SSSR, 162: 794-7(June 1, 1965). (In Russian).

The energy transfer in systems consisting of complex molecules is very difficult. These systems may be considered as being similar to a gaseous mixture containing molecules at various levels of excitation, requiring the determination of the conservation laws for each subsystem. In order to derive the needed operators, a model of particles with internal degrees of freedom was selected and defined mathematically. As a special case of the problem, irreversible processes in a spatially homogeneous system were examined; they involve a weakly interacting subsystem, such as a chemical reaction in a homogeneous phase, or temperature changes between the components of the mixture. A linear correlation was obtained for changes of the energy and of the number of particles of a given subsystem, assuming that the thermodynamic forces are relatively small. (TTT)

7068 THERMAL DISSOCIATION OF MOLYBDENUM DISULFIDE IN VACUUM. Opalovskii, A. A.; Fedorov, V. E. (Inst. of Inorganic Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 900-1(Aug. 1, 1965). (In Russian).

Thermal dissociation of molybdenum disulfide in vacuum was studied in a sealed quartz ampule evacuated to 1×10^{-5} mm Hg at up to 1300°C. The ampule was placed so that one end containing the sample was in the furnace and the other end, slightly raised, remained outside and cooled for collecting the dissociation product. Chemical and x-ray analysis revealed that thermal dissociation of MoS_2 in vacuum led to the formation of Mo_2S_3. (CFSTI)

7069 HEAT CAPACITY C_v OF HEAVY WATER NEAR THE CRITICAL POINT. Amirkhanov, Kh. I. (Dagestan Branch, Academy of Sciences, USSR); Stepanov, G. V.; Mursalov, B. A. Dokl. Akad. Nauk SSSR, 163: 1189-90 (Aug. 11, 1965). (In Russian).

The heat capacity at constant volume (C_v) of heavy water containing 99.8% deuterium was investigated. Measurements of C_v along several isochores were conducted near the critical point, using an adiabatic calorimeter. It is shown that for H_2O the transition from the two-phase state to the one-phase state takes place with an abrupt jump for a specific volume V = 2.5 cm^3/g, while for D_2O the same transition is smooth. For V = 2.7 cm^3/g the same transition was smooth for both H_2O and D_2O. While the critical temperature of D_2O could not be accurately determined, it was assumed to exceed the value of 370.9°C. (CFSTI)

7070 CALCINATION OF LANTHANUM AND PRASEODYMIUM OXALATES AND CHANGES IN SURFACE AREA OF THE PRODUCTS. Subba Rao, V. V.; Rao, R. V. G.;

Biswas, A. B. (National Chemical Lab., Poona, India). Indian J. Chem., 3: 482-5(Nov. 1965).

The thermal decomposition of lanthanum and praseodymium oxalates was studied in the temperature range from 30 to 950°C by measuring the surface areas and densities of the decomposition products. The mass loss estimation and infrared and x-ray analyses of the products were also carried out and correlated. The two oxalates showed one maximum only at ~470°C in the specific surface area-temperature of calcination plots, differing from cerous and neodymium oxalates, which showed two maxima in similar plots. The maximum was attributed to the decomposition and disintegration of the oxalates and the fall at higher temperatures due to the simultaneous operation of the two opposing processes, activation due to further decomposition dominated by the sintering process. (auth)

7071 THE CRYSTAL STRUCTURE OF SCANDIUM SESQUITELLURIDE. White, J. G.; Dismukes, J. P. (RCA Labs., Princeton, N. J.). Inorg. Chem., 4: 1760-3(Dec. 1965).

Scandium sesquitelluride was prepared in single-crystal form by a vapor transport technique. The crystals are rhombohedral with $a_h = 4.109 \pm 0.004$ Å, $c_h = 40.59 \pm 0.05$ Å, referred to the triply primitive hexagonal unit cell. The space group is $R\bar{3}m$ and the Te atoms form a 12-layer stacking sequence containing regions of both cubic and hexagonal close packing. All the Sc atoms are in octahedral sites. The structure may be regarded as being made up of alternate regions of NaCl and NiAs structure types, with the metal sites common to both regions being only one-third occupied. A nonstoichiometric scandium telluride of approximate composition $Sc_{2.3}Te_3$ was made, which also had the Sc_2Te_3 structure, presumably with a higher scandium content in the partially occupied sites. (auth)

7072 HIGH-TEMPERATURE CALORIMETRY IN LIQUID OXIDE SYSTEMS. II. THE ENTHALPIES OF SOLUTION OF OXIDES OF TYPE MO IN VANADIUM(V) OXIDE. Yokokawa, T.; Kleppa, O. J. (Univ. of Chicago). Inorg. Chem., 4: 1806-8(Dec. 1965).

The enthalpies of solution of ten different solid oxides in liquid V_2O_5 at 685 ± 5°C were measured. All solutes studied except BeO and CuO showed negative enthalpies of solution whose magnitude increased sharply in the sequence BeO < MgO < CaO < SrO < BaO. The results are discussed in terms of the acid–base character of the solution process. (auth)

7073 REACTIONS IN MOLTEN SALT SOLUTIONS. I. URANATE AND NEPTUNATE FORMATION IN MOLTEN LITHIUM NITRATE–SODIUM NITRATE. Carnall, W. T.; Neufeldt, S. J.; Walker, A. (Argonne National Lab., Ill.). Inorg. Chem., 4: 1808-13(Dec. 1965).

The reaction of U(VI), Np(V), and Np(VI) with BrO_3^- in molten $LiNO_3$–$NaNO_3$ resulted in the formation of solid compounds, which could be separated from the melt and characterized as mixed alkali metal–actinide oxide phases. The infrared spectra of these compounds, and their cell constants evaluated from x-ray diffraction patterns, were compared with those of pure $Na_2U_2O_7$, $Na_2Np_2O_7$, and $CaUO_4$. A close structural relation with the latter compounds is shown to exist. Interpretations of some of the infrared absorption bands of the compounds studied were offered, and U–O_I and Np–O_I bond distances were calculated. (auth)

7074 VOLATILE RARE EARTH CHELATES. Eisentraut, Kent J.; Sievers, Robert E. (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). J. Amer. Chem. Soc., 87: 5254-6(Nov. 20, 1965).

Volatile chelates of 15 trivalent rare earths were prepared and separated by gas chromatography. The ligand employed was 2,2,6,6-tetramethyl-3,5-heptanedione (dipivaloylmethane). Molecular weight measurements indicated that the compounds are monomeric in benzene. Infrared measurements showed the absence of O–H stretching vibrations and the close agreement of elemental analyses proved that the crystalline compounds are anhydrous. The complexes readily underwent vacuum sublimation without decomposition at temperatures between 100 and 200°C. The volatility differences made it possible to separate these rare earth complexes by fractional sublimation. The volatility of the complexes appeared to decrease as the size of the metal ion increased. (F.J.H.)

7075 THE QUENCHING OF MERCURY ($^3P_1$) ATOMS BY ISOTOPIC HYDROGEN MOLECULES. Yang, Kang (Continental Oil Co., Ponca City, Okla.). J. Amer. Chem. Soc., 87: 5294-5301(Dec. 5, 1965).

Isotope effects in the quenching of $Hg(^3P_1)$ by isotopic hydrogen molecules were investigated by chemical and physical methods. The chemical method utilizes a competition between the reactions $N_2O + Hg^* \rightarrow N_2 + O + Hg$ and $H_2 + Hg^* \rightarrow 2H + Hg$, etc. The quenching rate was deduced from the dependence of the quantum yield of nitrogen on $[H_2]$, [HD], or $[D_2]$. Propane or ethylene was added in the system to avoid the occurrence of the reaction $N_2O + H \rightarrow N_2 + OH$. In the physical method, the density of fluorescence, $Hg(^3P_1) \rightarrow Hg(^1S_0) + h\nu$, was measured at different $[H_2]$, [HD], or $[D_2]$, and the quenching rate was calculated on the basis of Stern–Volmer mechanism. The concentration of the quencher was kept sufficiently low so that collision broadening of absorption lines may be neglected. Even at 0°C, the vapor pressure of mercury was found to be high enough to cause severe imprisonment of the resonance radiation. Errors due to this were corrected by an empirical method. Relative quenching cross sections estimated by the two methods are given. A previous report on the reverse isotope effect between the collision efficiency of H_2 and D_2 was not confirmed. In the quenching by paraffins, D-substitution at the quenching site drastically reduced collision efficiency. Such a drastic reduction was not present in the collision involving isotopic hydrogen molecules. This difference is explained by supposing that the quenching by hydrogen molecules proceeds by the formation of a cyclic complex, while in the quenching by paraffins the formation of such a complex, involving the bond to be broken, encounters a high potential barrier. (auth)

7076 SOLUBILITY OF URANYL FLUORIDE IN HYDROFLUORIC ACID–NITRIC ACID SOLUTIONS AT 25 deg. Ferris, Leslie M. (Oak Ridge National Lab., Tenn.). J. Amer. Chem. Soc., 87: 5377-9(Dec. 5, 1965). (ORNL-P-1456).

At 25°C the solubility of UO_2F_2 in hydrofluoric acid solutions decreased from 4.82 to 0.15M (60.1 to 3.5 wt % UO_3) as the HF concentration increased from 0. to 28.4M (0 to 47.4 wt %). The equilibrium solid phase in this concentration range was $UO_2F_2 \cdot 2H_2O$. In HF–HNO_3 solutions the solubility decreased regularly with increasing hydrofluoric and nitric acid concentrations, but no change in equilibrium solid phase ($UO_2F_2 \cdot 2H_2O$) was noted. (auth)

7077 THE ROLE OF VIBRATIONAL EXCITATION IN HYDROGEN–DEUTERIUM EXCHANGE. NASCENT MOLECULES AT ROOM TEMPERATURE. Bauer, S. H.; Marshall, David; Baer, Tomas (Cornell Univ., Ithaca, N. Y.). J. Amer. Chem. Soc., 87: 5514-5(Dec. 5, 1965).

Studies of gas-phase D–H exchange reactions previously indicated that the exchange rate is limited by the rate of populating critical vibrational levels. Extension of the vibrational excitation mechanism to the reactions $C_2N_2 + H_2 \rightarrow 2HCN$ and $C_2N_2 + D_2 \rightarrow 2DCN$ predicted that the rate of the latter is faster than the former. It was found that DCN/HCN = 6(1050°K), 3(1130°K), and 1.6(1200°K). It was found that when the reaction between diazomethane and HBr or HCl was carried out at room temperature using D_2 or CD_4 as diluents, a fraction of the alkyl halides appeared as CH_2DX. This was due to D–H atom exchange, which occurred at room temperature between the nascent, vibrationally activated CH_3X and either D_2 or CD_4. The reaction of diazomethane with deuterium bromide in argon at room temperature and mass spectra analysis of the products are discussed. It is shown that vibrational ex-

citation in the absence of any significant translational contribution is sufficient for exchange. (F.J.H.)

7078 THE PREPARATION AND SPECTRA OF URANIUM PENTACHLORIDE COMPLEXES. Bagnall, K. W.; Brown, D.; du Preez, J. G. H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Chem. Soc., 5217-21(Oct. 1965).

Stable uranium pentachloride complexes with phosphine oxides, UCl_5, Ph_3PO (Ph_3-triphenyl) and UCl_5,$(C_8H_{17})_3PO$, were prepared from $CsUCl_6$. Magnetic data for UCl_5, Ph_3PO, and the absorption spectra of both complexes and of other stable uranium(v) solutions over the range from 0.4 to 2.0 μ, are reported. The complexes showed an unusually large P = O vibrational frequency shift. Other oxygen donor ligands were treated with $CsUCl_6$ but complexes could not be isolated. (auth)

7079 THE OXIDATION OF URANIUM(IV) BY THALLIUM(III) OVER AN EXTENDED CONCENTRATION RANGE IN AQUEOUS PERCHLORIC ACID SOLUTIONS. Wear, James O. (Sandia lab., Albuquerque, N. Mex.). J. Chem. Soc., 5596-5601(Oct. 1965).

Kinetics of the oxidation of uranium(iv) by thallium (III) were examined in aqueous perchloric acid solutions, with the concentrations of reactants varied over a 2000-fold range. The orders with respect to uranium(IV) and thallium(III) were different in different concentration ranges. The data are explained on the basis of combinations of three paths involving hydrolytic species. The temperature was varied from 15 to 50°C, and the activation energy found for each rate constant. (auth)

7080 SPECTROPHOTOMETRIC STUDY OF THE COMPLEX FORMATION BETWEEN URANYL IONS AND β-RESORCYLIC ACID. Desai, M. N.; Desai, B. M. (L. D. Arts Coll., and M. G. Science Inst., Ahmedabad, India). J. Indian Chem. Soc., 42: 643-8(Sept. 1965).

A spectrophotometric study was made of complexes of uranyl ion with β-resorcylic acid. The procedure, nature of the complexes formed, influence of H-ion concentration on the stability of the complex, and composition of the complex are discussed. (F.J.H.)

7081 ON THE COMPLEX FORMING TENDENCY OF PHENOLIC HYDROXYL WITH UO_2^{2+}. Bartusek, M.; Sommer, L. (Univ., Brno). J. Inorg. Nucl. Chem., 27: 2397-2412(Nov. 1965).

The complex equilibria of the uranyl ion with a number of mono-, di-, and trihydric phenols and 3-hydroxy-4-pyrones were studied and the stability constants calculated. Some general conclusions on the stability, structures, and optical properties of particular complexes are given and their significance for sensitive spectrophotometric determination of UO_2^{2+} in aqueous solution outlined. (auth)

7082 KINETICS OF THE REDUCTION OF NEPTUNIUM(V) WITH URANIUM(IV) IN AQUEOUS PERCHLORATE AND CHLORIDE MEDIA. Shastri, N. K. (Univ. of Arkansas, Fayetteville); Amis, E. S.; Wear, J. O. J. Inorg. Nucl. Chem., 27: 2413-22(Nov. 1965).

The kinetics of the reduction of neptunium (V) with uranium (IV) were studied in aqueous perchlorate and chloride media. The reaction was found to be complex. A possible mechanism was suggested, which explained the observed kinetics in both the cases. Specific velocity constants and activation energies were determined and compared with the values found in a separate study of neptunium (IV)–uranium (IV) reaction in similar media. (auth)

7083 A NEW SERIES OF SYNTHETIC MINERAL ION EXCHANGERS. II. FERROCYANIDE TUNGSTATE (FeW). Huys, D.; Baetsle, L. H. (Belgium Nuclear Research Center, Mol). J. Inorg. Nucl. Chem., 27: 2459-61(Nov. 1965).

A synthetic ion exchanger compound was prepared by mixing Na_2WO_4 and $H_4Fe(CN)_6$ in acid solution. The product was similar to ferrocyanide molybdate, but seemed to display a greater stability towards acids ranging from 0.5 to 2M. Equilibrium titration curves for different FeW products are shown. The chemical stability of the product in acid solution was investigated by preparing ^{185}W-labeled FeW precipitates. The solubility was low and varied between 0.2 and 0.6%. The distribution coefficients for Cs, Sr, and Ce at trace concentration were determined as a function of the HNO_3 molarity. Batch experiments showed that the time to reach equilibrium depends on the ionic valency. Because of its greater stability towards acids it was considered preferable to use FeW instead of FeMo as a Cs-selective ion exchanger, but the low capacity and slow reaction rate limits its practical value. (F.J.H.)

7084 THE DESORPTION AND ISOTOPIC EXCHANGE OF OXYGEN AT A SILVER SURFACE. Sandler, Y. L.; Durigon, D. D. (Westinghouse Electric Corp., Pittsburgh). J. Phys. Chem., 69: 4201-7(Dec. 1965).

Pressure–temperature scans with oxygen on porous silver, as well as the onset of the homonuclear exchange $^{16}O_2 + {}^{18}O_2 \rightarrow 2{}^{16}O{}^{18}O$, showed that the chemisorption becomes partly reversible at about 160°C. Measurements of the exchange rate were carried out at 160 to 180°C, followed by fast removal of the gas phase and determination of the desorption rate and of the isotopic composition of the desorbing gas. It is thus shown in two independent ways that the desorption rate is equal to the rate of exchange. The chemisorbed oxygen exists in two binding states, but no evidence was found that one is in undissociated form. An increase in the proportion of the firmly bound form reduced the desorption rate but caused no change in the activation energy of desorption, which was 32.5 kcal/mole of O_2. The results showed that while rapid diffusion and exchange takes place over the entire outer surface, desorption occurs only from those regions that are free of the firmly bound oxygen. (auth)

7085 THE CONDUCTANCE OF THE TETRAALKYLAMMONIUM HALIDES IN DEUTERIUM OXIDE SOLUTIONS AT 25 deg. Kay, Robert L.; Evans, D. Fennell (Mellon Inst., Pittsburgh). J. Phys. Chem., 69: 4216-21 (Dec. 1965).

Precise conductance measurements were carried out on dilute solutions of Me_4NBr, Et_4NBr, Pr_4NBr, Bu_4NBr, Me_4NI, and Bu_4NI in essentially pure D_2O at 25°C. The change in the ratio of the Walden product for D_2O solutions relative to H_2O solutions is explained by the increased structure in D_2O solutions. The concentration dependence of conductance for these salts in dilute solution was almost identical with that found for H_2O solutions in that unrealistically low ion size parameters were obtained, which decrease with increasing anion size. As was the case with H_2O solutions, the data for Bu_4NI showed a small amount of association. (auth)

7086 KINETICS OF THE ATTACK OF MOLYBDENUM BY DISSOCIATED CHLORINE. Rosner, Daniel E.; Allendorf, H. Donald (Pfaudler Permutit Inc., Princeton, N. J.). J. Phys. Chem., 69: 4290-6(Dec. 1965).

The true kinetics of the attack of molybdenum surfaces by both atomic and diatomic chlorine were studied using microwave discharge fast flow system techniques coupled with electrical resistance heating and monitoring of the reacting specimens. Experimental results are reported over the surface temperature range from 400 to 1530°K, at reactant partial pressures of the order of 10^{-3} to 10^{-1} torr. In contrast to the behavior of nickel, dissociation markedly increased the chlorination probability of molybdenum over the entire temperature range investigated; the enhancement was of the order of 100-fold at about 1000°K. The high reaction probability for $Cl_2(g)$ attack of high-temperature nickel, previously reported by McKinley and Shuler, was verified. When exposed to dissociated chlorine, the ratio of the nickel chlorination rate to the Cl atom recombination rate decreased with decreasing surface temperature; on 420°K nickel filaments the recombination coefficient γ was found to be $\frac{1}{2}$. The implications of these results with regard to dissociative adsorption on and evaporation from nickel and molybdenum surfaces are discussed in the light of available kinetic and thermochemical data for these and related heterogeneous reactions. (auth)

7087 ENTHALPIES OF FORMATION OF GASEOUS TANTALUM OXIDE AND TANTALUM DIOXIDE. Krikorian, Oscar H.; Carpenter, John H. (Univ. of California, Livermore). J. Phys. Chem., 69: 4399-4401(Dec. 1965). (UCRL-14229).

Calculated pressures of TaO and TaO_2 above a Ta_2O_5 solid solution in tantalum are given. TaO and TaO_2 are assumed to be formed by the reactions (1) $\frac{3}{5}$ Ta(s) + $\frac{1}{5}$ Ta_2O_5 (in solid solution) = TaO(g) and (2) $\frac{1}{5}$ Ta(s) + $\frac{2}{5}$ Ta_2O_5 (in solid solution) = TaO_2(g), where the Ta_2O_5 activity was lowered by solution in tantalum. If the Ta_2O_5 activity remained fixed during the measurements, reactions 1 and 2 could be combined to give Ta(s) + TaO_2(g) = 2 TaO(g). Enthalpies of formation of TaO(g) and TaO_2(g) were determined. The dissociation energies were calculated to be 7.9 ± 0.2 ev for TaO and 15.1 ± 0.2 ev for TaO_2. (F.J.H.)

7088 DISSOCIATION CONSTANTS FOR SOME NITROPHENOLS AND SALICYLIC ACID IN DEUTERIUM OXIDE. Glasoe, Paul K. (Wittenberg Univ., Springfield, Ohio). J. Phys. Chem., 69: 4416-17(Dec. 1965).

The dissociation constants of o-nitrophenol, p-nitrophenol, 2,4-dinitrophenol, and salicylic acid in deuterium oxide were determined and compared to values for water The data were obtained by using a glass electrode. (F.J.H.)

7089 PREPARATION AND PARAMAGNETISM OF THE RARE EARTH TRIFLUORIDES. Kern, S.; Raccah, P. M. (Massachusetts Inst. of Tech., Lexington). J. Phys. Chem. Solids, 26: 1625-8(Nov. 1965).

The magnetic susceptibilities of the rare earth trifluorides were measured. They all exhibited moments close to that theoretically expected for the free ion, except at the very low temperatures. (auth)

7090 STUDY ON U_4O_9. PART I. AN ANOMALY OF THE HEAT CAPACITY NEAR THE ROOM TEMPERATURE. Gotoo, Kunihiro; Naito, Keiji (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Chem. Solids, 26: 1673-7 (Nov. 1965).

The specific heat of U_4O_9 was measured over the range from 300 to 520°K. A λ-type anomaly with a maximum at 330°K was observed. The entropy and enthalpy increments associated with the λ-type transition were about 2.00 eu and 680 cal per mole of U_4O_9, respectively. This transition may be related to a small contraction of the lattice constant of U_4O_9 from room temperature to 80°C. (auth)

7091 STUDY ON U_4O_9. PART II. MAGNETIC SUSCEPTIBILITY OF U_4O_9. Gotoo, Kunihiro; Nomura, Shinzo; Naito, Keiji (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Chem. Solids, 26: 1679-84(Nov. 1965).

The magnetic susceptibility of U_4O_9 was measured over the temperature range from 77 to 500°K. It showed paramagnetic behavior. At 330°K where U_4O_9 showed a λ-type anomaly in the specific heat, no magnetic transition was observed. The susceptibility of $\frac{1}{4}$ U_4O_9 after correction for diamagnetism is expressed by the equation, $\chi = 420 \times 10^{-6} + 0.530/(T + 55)$ cm^3, from which the effective moment and the Weiss constant of $\frac{1}{4}$ U_4O_9 can be derived as 2.06 BM_2 and 55°K, respectively. The susceptibility data are discussed in terms of ground state configurations f^2 and f^1 perturbed by the crystalline field, and it is likely that the composition of U_4O_9 involves a U(IV)–U(V) mixture. (auth)

7092 NUCLEAR MAGNETIC ENERGY LEVELS AND SYMMETRY WAVE FUNCTIONS FOR SIX CHEMICALLY EQUIVALENT SPIN ½ NUCLEI WITH $C_{3v} \times C_i$ SYMMETRY. Neszmelyi, A. (Hungarian Academy of Sciences, Budapest). Mol. Phys., 9: 579-83(1965).

The nuclear Zeeman energy levels of six chemically equivalent and interacting spin ½ nuclei with $C_{3v} \times C_i$ symmetry are calculated and the symmetry adapted spin-functions are given. (auth)

7093 NOMADIC BEHAVIOUR OF YTTRIUM IONS AND THEIR STRUCTURE IN SOLUTION. Vickery, R. C. Nature, 208: 678-9(Nov. 13, 1965).

The ability of yttrium ions to locate at varying sites in the lanthanon series was found to be attributable to its participation in hydroxy polymer formation. The structures formed are of the type formed by aluminum ions and in scandium solutions. The formation of polymers based on hydroxyl-bonded yttrium ions necessitates the existence of a Y–O association. Analysis of diffraction patterns and radial distribution functions showed that this exists in sulfate and nitrate solutions and can occur in chloride solutions. The sequential separation location of yttrium is determined by these polymers according to the polarization factor of the reactant system. (M.C.G.)

7094 FORMATION OF CYANIDE IN LIQUID SODIUM. Hobart, E. W.; Bjork, R. G. (Pratt and Whitney Aircraft, CANEL, Middletown, Conn.). Nucl. Appl., 1: 490-2(Oct. 1965). (TID–21910).

Experiments were performed, which demonstrated the formation of cyanide in liquid sodium. Various carbon- and nitrogen-containing additives were weighed and placed in molybdenum cups. Approximately 1g of sodium was placed in each cup in an argon- or nitrogen-filled dry box. The loaded cups were placed in Inconel outer capsules and sealed. The bottom 4 in. of the capsule were heated in an upended laboratory furnace. The rapid formation of significant quantities of cyanide was demonstrated. (F.J.H.)

7095 HELIUM AND ARGON DIFFUSION IN MAGNESIUM. Glyde, H. R.; Mayne, K. I. (Clarendon Lab., Oxford). Phil. Mag. (8), 12: 919-37(Nov. 1965).

The diffusion coefficients of He and Ar in Mg, obtained by measuring the rate of release of artificially introduced atoms from Mg sheet annealed at constant temperatures, were found to be: $D^{He} = 50 \pm 25 \exp[(-39.0 \pm 1.5/RT) \times 10^3]$ cm^2/sec (a), $D^{Ar} = 10^4 \exp[(-52.0 \pm 1.5/RT) \times 10^3]$ cm^2/sec, $D^{He} = 60 \pm 20 \exp[(-36.0 \pm 3.0/RT) \times 10^3]$ cm^2/sec (b), and $D^{3He}/D^{4He} \leq 1.095 \pm 0.020$, $D^{36Ar}/D^{40Ar} \leq 1.01 \pm 0.005$. The coefficients (a) and (b) were obtained from Mg samples in which the He concentration was $f_{He} \sim 1 \times 10^{-6}$ and $f_{He} \sim 3$ to 6×10^{-9} (atomic fraction), respectively, and D^{40Ar} from samples in which $f_{Ar} \sim 2 \times 10^{-5}$. Both D^{He} and D^{Ar} appeared to be concentration dependent. The isotope measurements require He and Ar diffusion by a mechanism involving vacancies; the vacancy or interstitialcy of the accepted mechanisms. There was no evidence of He or Ar gas bubble formation in Mg. (auth)

7096 HELIUM DIFFUSION IN ALUMINIUM. Glyde, H. R.; Mayne, K. I. (Clarendon Lab., Oxford). Phil Mag. (8), 12: 997-1003(Nov. 1965).

The diffusion in Al of reaction product He was measured by observing its rate of release from Al sheet on a mass spectrometer. Trapping of the He in Al was observed, but, prior to the trapping, the diffusion coefficient was measured as: $D = 3.0 \pm 1.5 \exp[(-36.5 \pm 1.5/RT) \times 10^3]$ cm^2/sec. The average distance the He atoms must migrate in the Al to be trapped (obtained from the anneal curve shapes) depended on the anneal temperature and was ~1 to 3×10^{-4} cm. This distance and its temperature dependence are best explained if He is trapped by diffusing to irradiation-created vacancy clusters. (auth)

7097 NATURE OF THE INTERACTION OF TITANIUM NITRIDE WITH METALS OF THE IRON, MOLYBDENUM AND TUNGSTEN GROUP. Kazakov, V. K. (Inst. of Problems in Studies of Materials, Academy of Sciences, Ukrainian SSR). Porosh. Met., Akad. Nauk Ukr. SSR, No. 10, 80-4(Oct. 1965). (In Russian).

The nature of the reaction of titanium nitride with Fe, Co, Ni, Mo, and W is discussed, and the shrinkage coefficients and strength properties of some alloys were determined. (auth)

7098 CATHODE-LUMINESCENCE SPECTRA OF SAMARIUM AND DYSPROSIUM IMBEDDED IN MAGNESIUM OXIDE. Iwase, Eiichi; Nishiyama, Seijiro (Inst. of Physical and Chemical Research, Tokyo). Rika Gaku Kenkyusho Hokoku, 38: 34-40(1962). (In Japanese).

An aqueous solution of samarium nitrate containing a minute quantity of dysprosium nitrate was adsorbed on various magnesium compounds, which were converted to magnesium oxide by thermal decomposition. After the

mixture was heated between 600 and 1800°C, the luminescence spectrum was investigated under the excitation of cathode rays. Samples of magnesium oxide thus prepared gave luminescence spectra differing considerably from each other according to whether the temperature of the thermal treatment was comparatively low, e.g., below 900°C, or very high, e.g., 1800°C. The effect of high-temperature treatment on the change of luminescence spectrum was especially noted; while luminescence bands due to samarium decreased in intensity, those due to dysprosium markedly increased. Marked variations occurred in the luminescence spectrum of samarium when its sulfate or chloride form were in contact with magnesium oxide. (BBB)

7099 THE FAR-INFRARED SPECTRA OF SOLID H_2S AND D_2S AT 5 deg K AND 77 deg K. Taimsalu, Parn; Robinson, Dean W. (Johns Hopkins Univ., Baltimore). Spectrochim. Acta, 21: 1921-6(Nov. 1965).

The infrared spectra of solid H_2S and D_2S were recorded between 350 and 60 cm^{-1} at 5 and 77°K. Both substances gave five bands of librational and four of translational origin. On cooling to 5°K the bands showed considerable sharpening and a small shift to higher frequencies. The observed spectra fit reasonably well with the group-theory prediction based on a structure $P4_2(C_4^3)$ for H_2S. (auth)

7100 THERMODYNAMICS OF METALLO-THERMIC REDUCTION OF OXIDES OF ZIRCONIUM AND TITANIUM IN DIFFERENT GASEOUS MEDIA. Roy, S. Trans. Indian Inst. Metals, 17: 122-6(Sept. 1964).

Thermodynamic calculations of the free energies of formation and dissociation of the respective compounds are used to show that Mg can reduce the oxides of Zr and Ti much further in active atmospheres such as N_2 and H_2 than in inert atmospheres. (Rev. Metal Lit.)

7101 SERIES DEVELOPMENTS IN THE STATISTICAL THERMODYNAMICS OF ISOTOPES SYSTEMS. Vojta, G. (Arbeitsstelle fuer Statistische Physik, Leipzig. Karl-Marx-Univ., Leipzig). Z. Phys. Chem. (Leipzig), 230: 106-11(1965). (In German).

Two proofs of the Bigeleisen series expansion for reduced partition function ratios of isotopic molecules are given. The corresponding expansions for the isotopic exchange equilibrium constants and for the reduced differences of thermodynamic functions including the chemical potentials were derived. (auth)

7102 INVESTIGATION OF Li–Cr FERRITES WITH THE HELP OF THE MOESSBAUER EFFECT. Ritter, Gerhard (Univ., Erlangen, Ger.). Z. Physik, 189: 23-32(1966). (In German).

The hyperfine-structure spectra of the 14.4-kev γ ray of the nucleus ^{57}Fe in the spinel type ferrite ($Li_{.5}^{1+} Fe_{1.3}^{3+} Cr_{1.2}^{3+} O_4^{2-}$) were measured through the use of the Mössbauer effect. These measurements were performed on powder samples at different temperatures between 88 and 633°K. For the Fe^{3+} ions at both the tetrahedral (A) and octahedral (B) sites at 88°K the effective magnetic field H at the Fe nuclei is the same and equal to 504 ± 4 kG. The temperature dependence of H_A however is different from H_B. Application of an external magnetic field of 20 kG shows that the sign of H_A is positive and the sign of H_B is negative. As the temperature is increased a considerable broadening of the magnetic hfs lines (and especially of the outer pair of lines) is observed. No theoretical discussion directly applicable to these measurements is as yet available. In the paramagnetic phase a well resolved doublet is obtained. It appears that this doublet must be interpreted as a quadrupole splitting. (auth)

7103 ON THE CONDUCTANCE OF A SOLID ELECTROLYTE 0.85 ThO_2 + 0.15 La_2O_3. Vecher, A. A.; Vecher, R. A.; Geiderikh, V. A.; Vasil'eva, I. A. (Moscow State Univ.). Zh. Fiz. Khim., 39: 2080-1(Aug. 1965). (In Russian).

Studies of a galvanic cell with an ionically conducting solid electrolyte of the type $O_2(\mu O_2)$ || O^{2-} || $O_2(\mu\bar{O}_2)$ revealed that the nature of the conductance may change; very low partial pressures may lead under certain conditions to an electronic type of conductance. At the same time, the ionic transference number changes from 1 for ionic conductance to 0 for the case in which the system become an electronic conductor. A formula was derived to calculate the average ionic transference number t_{ion} from the thremodynamic emf, E_0, and the experimentally determined value E: $\bar{t}_{ion} = (E/E_0)$. The widely used solid electrolyte 0.85 ThO_2 + 0.15 La_2O_3 was studied by this method. The emf of the cell (Pt)Si, SiO_2 || 0.85 ThO_2 + 0.15 La_2O_3 || FeO, Fe(Pt) was determined at 1000°K. The experimental value was 300 ± 20 mv; the calculated thermodynamic value was 797 ± 20 mv, yielding a $\bar{t}_{ion}$ = 0.38 ± 0.03 for Si, SiO_2 ($p_{O_2} \cong 10^{-37}$ atm) and Fe, FeO ($p \cong 10^{-21}$ atm). This value agreed with findings reported by H. Schmalzried for the electrolyte 0.85 ZrO_2 + 0.15 CaO under nearly identical conditions. These results indicated that no thermodynamic measurements may be made by the emf method for solid electrolytes with SiO_2 because the electronic conductance plays an important role in the process and the cell does not operate reversibly. (TTT)

7104 DIFFUSION IN CONCENTRATED URANYL NITRATE SOLUTIONS [Thesis]. Finley, John Browning. Stillwater, Okla., Oklahoma State Univ., 1964. 160p.

Molecular diffusion coefficients of concentrated solutions of uranyl nitrate were measured by the capillary technique. The classical solution with constant coefficient of Fick's Second Law was used to calculate the diffusion coefficients from experimental measurements. A numerical solution of Fick's Second Law, assuming a polynomial dependence of the diffusion coefficient on concentration, was devised. The results of these two calculational methods were substituted in the Onsager-Fuoss and the Nernst-Hartley relationships for dilute electrolytes. Included in the study was the measured effect of nitric acid concentration on the diffusion coefficients of uranyl nitrate. An experimental determination of the diffusion coefficient of the uranyl nitrate-tributyl phosphate complex was also made. The differential diffusion coefficient of uranyl nitrate diffusing into water was calculated by numerical methods, assuming a polynomial dependence of D on the concentration. The differential values were generally higher than an equivalent integral diffusion coefficient. The differences between the two values varied with the initial concentration of the solute. The effect of an increase in nitric acid concentration in the solvent phase was to lower the diffusion coefficient of the uranyl nitrate. The effect was more pronounced as the uranyl ion concentration was increased. The internal sample liquid scintillation method of analysis for uranium was found to be sufficiently accurate for the analyses of capillary samples. The method resulted in the adoption of ordinary radioactive assay equipment and had the advantage of providing radioactive assays with a minimum of sampling handling. (Dissertation Abstr.)

7105 PREPARATION OF ANHYDROUS METAL CHLORIDES FROM METAL OXIDES AND METAL SULFIDES BY ACTION OF CHLOROCARBON SOLVENTS AT ELEVATED TEMPERATURES [Thesis]. Bardawil, Abdo Bishara. Chapel Hill, N. C., Univ. of North Carolina, 1964. 86p.

Section I deals with the reaction of metal sulfides with CCl_4 in a sealed glass tube at elevated temperature and pressure for several hours. Anhydrous WCl_6, $MoCl_5$, and $ReCl_5$ were obtained in the pure form from WS_3, WS_2, MoS_3, and Re_2S_7, respectively. Anhydrous $FeCl_3$ and $MoCl_5$, admixed with small amounts of acid-insoluble residues, were obtained from iron pyrite ore (FeS_2) and from commercial FeS, and MoS_2, respectively. Section II deals with the reaction of metal oxides and metal sulfides with octachlorocyclopentene at atmospheric pressure and the boiling point of the organic solvent. Anhydrous $NbCl_5$, $FeCl_3$, $TiCl_4$, $VOCl_3$ mixed with VCl_3, $WOCl_4$, and $MoOCl_3$ were obtained from Nb_2O_5, FeS, iron pyrite ore (FeS_2), Fe_2O_3, TiO_2, V_2O_5, WO_3, and MoO_2, respectively. In these reactions, $FeCl_3$ was separated by sublimation, $VOCl_3$ and $TiCl_4$ were separated by distillation, and the rest were separated by simple filtration from the reaction mixtures. Molybdenum

(VI) oxide did not give a single stoichiometric product while the sulfides, MoS_2, MoS_3, Re_2S_7, TiS_2, WS_2, and the oxides, Al_2O_3, ZrO_2, and Ta_2O_5 showed little or no reaction with octachlorocyclopentene. In section III, the reactions of MoS_3, Re_2S_7, FeS, iron pyrite ore (FeS_2), MoS_2, and TiS_2 with hexachloropropene, and the reactions of FeS_2, FeO_3, and WO_3 with hexachlorocyclopentadiene are discussed. Only the reaction of WO_3 with hexachlorocyclopentadiene gave a single stoichiometric product. Section IV consists of an elementary study of the infrared spectra of the organic by-products. (Dissertation Abstr.)

7106 CATALYTIC EXCHANGE OF DEUTERIUM GAS WITH WATER AND WITH ACETIC ACID AND THE EFFECT OF POISONS ON THESE REACTIONS [Thesis]. Jones, Marvin Luther. Knoxville, Tenn., Univ. of Tennessee, 1965. 96p.

Kinetic data for the exchange of deuterium gas with water and with acetic acid over a supported rhodium catalyst were obtained. The exchange is one-half order with respect to deuterium pressure for water above 20° and for acetic acid at all temperatures studied. The dependence of the exchange on the concentration of acceptor is first order with water and 1.6 order with acetic acid. The exchange reaction with water is essentially independent of the hydrogen ion concentration, the ionic strength, and the concentration of unionized acid. The activation energies were found to be 7.8 kcal $mole^{-1}$ for the exchange with water and 4.2 kcal $mole^{-1}$ for the exchange with acetic acid. The effect of poison was studied on both exchange reactions. Adsorption equations were developed through an extension of the Langmuir adsorption theory to include two reactants and a poison. These equations indicate that it is possible to distinguish between a Langmuir-Hinshelwood mechanism and a Rideal-Eley mechanism by a determination of the order with respect to poison concentration. The data for the effect of poison on the two exchange reactions were treated in accordance with the theory of controlled catalytic poisoning. The results suggest that a Langmuir-Hinshelwood mechanism applies to the exchange reactions at 30.0°C. (Dissertation Abstr.)

7107 A HIGH TEMPERATURE TORSION EFFUSION STUDY OF THE SYSTEMS ThO_2–C–ThC_2–CO AND ZrO_2–C–ZrC–CO [Thesis]. Hollahan, John Ronald. Seattle, Univ. of Washington, 1964. 133p.

The general reaction A(s) + B(s) = C(c) + D(g) was examined by the torsion effusion technique. A high temperature vacuum apparatus was constructed and made operational for experiments requiring temperatures in a range 900–1700°C. Results from one system studied, ThO_2(c) + 4C(graphite) = ThC_2(c) + 2Co(g), indicate that CO steady state effusion pressures are close to equilibrium values calculated from thermal data. The heats of the reaction at 298°K obtained by both the second and third law methods agree within experimental uncertainty. The entropy change for the reaction at 298°K agrees within the limits of uncertainty in the free energy functions to the value calculated using the second law. Also investigated were the effects of sample size, sample composition, and sample depletion. Another system studied, ZrO_2(c) + 3C(graphite) = ZrC(c) + 2CO, gave effusion pressures significantly below expected equilibrium pressures. The second law heat of reaction at 298°K, treating the steady state pressures as though they were equilibrium values, agreed well with the reaction heat predicted from heat of formation data for the reactants and products. The entropy change for the reaction was about 20 eu below the expected change. The explanation for the behavior of the ZrO_2–ZrC–CO system may be associated with the dissimilarity of the ZrO_2 and ZrC structures. This study shows that the extrapolation of effusion pressures to zero orifice size cannot be relied upon to give equilibrium values. A check of apparent equilibrium pressures by both the second and third law methods is necessary. (Dissertation Abstr.)

7108 THE EFFECT OF TARTARIC ACID ON THE KINETICS OF THE OXIDATION OF URANIUM(IV) BY THALLIUM(III) IN AQUEOUS PERCHLORATE MEDIA [Thesis]. Love, Calvin Miles. East Lansing, Mich., Michigan State Univ., 1964. 134p.

The kinetics of the oxidation of uranium(IV) by thallium(III) in the presence of tartaric acid were investigated in aqueous perchloric acid solutions. Increases in initial rate with increasing tartaric acid concentrations were observed, along with departure from apparent second-order kinetics. The orders with respect to uranium(IV), thallium(III), tartaric acid, and hydrogen ion were found to be 0.93, 0.05, 0.37, and −0.91, respectively. Thallium(III) in the presence of tartaric acid was shown polarographically to be stable, yet under kinetic run conditions where thallium(III) is in excess over uranium(IV), the reactions stopped because the thallium(III) was consumed. The oxidation of uranium(IV) by oxygen of the air is catalyzed by the presence of tartaric acid, but this reaction is negligibly slow compared to the uranium(IV)–thallium(III)–tartaric acid reactions. The presence of oxygen, uranium(VI), and thallium(I) were shown to have no effect on the reaction kinetics. A mechanistic interpretation was developed to account for the observed results. (Dissertation Abstr.)

7109 CRYSTAL FIELD SPLITTING IN RARE EARTH CHELATES [Thesis]. Perkins, Walter George. Albuquerque, N. Mex., Univ. of New Mexico, 1965. 181p.

Investigations of ligand field effects in the spectra of trisdibenzoylmethide, trisbenzoylacetonate, and trisacetylacetonate chelates of trivalent ytterbium and thulium are reported. Chelate absorption and luminescence spectra corresponding to intra-4f electronic transitions exhibit line splittings similar in magnitude to the crystal field splitting observed in the spectra of inorganic complexes of the rare earth ions. The quantum theory of atomic structure (with particular reference to rare earth ions) is discussed, beginning with a review of the variational techniques of calculation for free atoms and ions (in the central field approximation) and including a presentation of prescriptions for the use of the theory of group representations as an aid in the calculations. A detailed calculation of the energy levels of trivalent thulium is carried out for the case of intermediate spin-orbit coupling. The splitting of the free-ion energy levels of rare earths in chelates is discussed from the point of view of each of two theories. Comparison of the experimental energy levels of chelated Yb^{3+} and Tm^{3+} with predictions of the two theories leads to much better agreement between theory and experiment for the electrostatic crystal field calculation than is obtained using the contact potential. Preliminary calculations of coordination energies for rare earth chelates, based on the electrostatic model, indicate that crystal field splitting in these complexes probably will produce only very small effects on their thermodynamic properties. (A.G.W.)

7110 KINETICS, PHASE EQUILIBRIA, AND CRYSTAL CHEMICAL STUDIES IN RARE EARTH OXIDE–ALKALINE EARTH OXIDE SYSTEMS [Thesis]. Barry, Thomas Leo. University Park, Pa., Pennsylvania State Univ., 1964. 129p.

Phase relations in some representative rare earth oxide–alkaline earth oxide systems were investigated prior to the study of solid state kinetics of reactions that occur in these systems. The reactions covered involved the thermal decomposition of a single crystalline phase. Two different examples of this type of reaction were investigated: (a) the dissociation of a binary compound into the constituent oxides and (b) the precipitation of solute from a crystalline solution. In addition, various crystal chemical studies were carried out on phases encountered in these systems. Four new crystalline phases were detected in the CaO–Yb_2O_3 system: $Yb_2O_3 \cdot 3CaO$, $Yb_2O_3 \cdot 2CaO$, $Yb_2O_3 \cdot CaO$, and $2Yb_2O_3 \cdot CaO$. The $2Yb_2O_3 \cdot CaO$ phase is metastable and was obtained only by rapid quenching from the melt. All four compounds dissociate into CaO plus Yb_2O_3 at temperatures below 1800°C. Only one new crystalline phase was detected in the CaO–Gd_2O_3 system. This compound, $2Gd_2O_3 \cdot CaO$, also possesses a stability minimum. The CaO–La_2O_3 system was found to be a simple eutectic system. Both experimental and calculated diagrams are given. The kinetics of decomposition of $CaYb_2O_4$ were studied employing quanti-

tative analysis by x-ray diffraction methods utilizing a modified method of "standard binary mixtures." This reaction is shown to proceed according to "zero order" kinetics. The kinetics of precipitation of Yb_2O_3 from CaO crystalline solutions was studied by in situ examination employing high-temperature x-ray methods. Kinetic plots show this process to be diffusion controlled at least in the initial stages. The existence of two new families of binary rare earth compounds with the molar ratios 1:1 and 2:1, rare earth oxide to alkaline earth oxide, was established. The defect type produced when trivalent rare earth ions are accepted into the sodium chloride structure was determined, from precise measurements of lattice parameters and densities, to be cation vacancies. An empirical calculation for obtaining the extent of crystalline solubility, based on the simplest assumptions of additivity and ideality, was devised. (Dissertation Abstr.)

7111 THE ELECTROCHEMISTRY OF TITANIUM, ZIRCONIUM AND HAFNIUM IN MOLTEN LITHIUM CHLORIDE–POTASSIUM CHLORIDE EUTECTIC [Thesis]. Baboian, Robert. Troy, N. Y., Rensselaer Polytechnic Inst., 1964. 174p.

The methods of potentiometry and polarography were applied to study the behavior of the group IVB transition metals titanium, zirconium, and hafnium in the LiCl-KCl eutectic melt. This behavior was found to depend strongly on the purity of the melt. Some observations of the effect of impurities in the melt were observed. Solubilities of the metals and their oxides were also investigated. Solutions of Ti(II) in the temperature range 450° to 550°C were prepared by the anodic dissolution of Ti metal. A procedure for the coulometric titration of Ti(II) was developed, which produced solutions of Ti(III). Standard potentials were obtained for the related electrode systems and polarograms of the solutions were recorded. Anodic dissolution of Zr metal yielded Zr(IV) at 450°C and primarily Zr(II) at 550°C. Zr(III) was not observed. Standard potentials were obtained for the stable electrode systems and the polarographic behavior of Zr(IV) and Zr(II) in the melt was investigated. Anodic dissolution of Hf metal in the temperature range 450° to 550°C produced solutions of Hf(IV). Polarograms of these solutions were recorded and the standard potentials of the Hf(IV)-Hf(O) electrode system were obtained. The potentiometric and polarographic behavior of these systems along with thermodynamic calculations established the positions of the electrode systems in an electromotive force series, was valuable in studying the course of chemical reactions and electrode processes in the melt, and produced information involving complex formation and interactions between the various species in the melt. (Dissertation Abstr.)

7112 THE HIGH TEMPERATURE RADIOSULFUR EXCHANGE REACTION OF SULFUR DIOXIDE WITH CONCENTRATED SULFURIC ACID AND AMMONIUM BISULFATE [Thesis]. Bairakdar, Hiyam. Corvallis, Ore., Oregon State Univ., 1965. 132p.

The rates of isotopic sulfur exchange between sulfur dioxide and various sulfur (VI) solutions were studied at temperatures from 167.5° to 225.3°C. The sulfur (VI) systems examined included 100% H_2SO_4, fused ammonium bisulfate, mixtures of ammonium bisulfate and 100% H_2SO_4, and a 1:1 mixture of ammonium bisulfate and 84.5% H_2SO_4. The observed rates were all conveniently measurable throughout the indicated temperature range. An effort was made to interpret both the present results and previous data in terms of sulfur dioxide activities rather than concentrations. To this end the previously used equation Rate = $k(SO_2)$ was rewritten as Rate = $k_a\gamma(SO_2)$ where (SO_2) represents dissolved SO_2 concentration and γ is the activity coefficient of sulfur dioxide in the solutions. In order to calculate the rate constants based on sulfur dioxide activities (k_a), the concentration rate constants (k) and activity coefficients (γ) were first calculated. A comparison between the two types of rate constants, k and k_a, shows that, while the constants, k, vary drastically from one solution to another, the activity constants, k_a, vary among themselves to only a modest degree. Apparent activation energies, frequency factors and activation entropies, both for k values and k_a values, have been calculated for the systems: (1) fused ammonium bisulfate; (2) 100% H_2SO_4; and (3) 1:1 ammonium bisulfate and 84.5% H_2SO_4. It was found that, even though the k_a values themselves showed good accord among themselves as compared to the k values, these related kinetic parameters failed to reflect this accord. It is suggested that the basis for this lack of concordance among the latter parameters may be related to the fact that the activity coefficients of the sulfur (VI) exchanging species and of the activated complexes have not been adequately taken into account. It is tentatively proposed that the exchange rate may be, at least approximately, described, for all the solutions here examined by the rate law Rate = $k_2\gamma(SO_2)[(HSO_4^-) + (H_2SO_4)]$. (A.G.W.)

7113 THE SATURATED LIQUID AND VAPOR DENSITY OF CESIUM TO 3000 F, AND THE CRITICAL POINT OF CESIUM. Hochman, Jack M. (Atomics International, Canoga Park, Calif.); Bonilla, Charles F. pp 122-30 of Advances in Thermophysical Properties at Extreme Temperatures and Pressures. New York, The American Society of Mechanical Engineers, 1965.

The volumes of the liquid and vapor phases of cesium in a vertical tube were found by passing direct current lengthwise along the tube and locating the liquid level by the voltage drop. The test was carried out with three known weights of cesium and to temperatures above 3000°F. Simultaneous solution yielded the densities of the liquid and vapor phases as functions of temperatures. The critical temperature of cesium was estimated at 3650°R (3190°F) by a reduced density comparison with mercury, in agreement with an earlier reduced electrical resistivity comparison. The predicted critical pressure is 130.8 atmos abs and the density 0.451 g/cc. (auth)

7114 ENTHALPY MEASUREMENTS OF SOLID MATERIALS TO 2400C BY MEANS OF A DROP TECHNIQUE. Conway, J. B.; Hein, R. A. (General Electric Co., Cincinnati). pp 131-7 of Advances in Thermophysical Properties at Extreme Temperatures and Pressures. New York, The American Society of Mechanical Engineers, 1965.

A drop technique is described for use in measuring enthalpies of solid materials to 2400°C. Capsulated specimens are heated in a tungsten tube furnace and then dropped into a modified Parr adiabatic water calorimeter. Data for rhenium to 2370°C, niobium to 2320°C, and chromium to 1830°C are reported and compared to existing lower temperature data. A similar comparison was also made in terms of heat capacity. Testing in a hydrogen atmosphere was found to yield the most satisfactory results not only in the shorter equilibrium times obtained, but also with respect to capsule contamination. Data are presented which identify the effect of shutter opening on enthalpy measurements when employing the drop technique. (auth)

7115 HIGH-TEMPERATURE THERMODYNAMIC FUNCTIONS FOR REFRACTORY COMPOUNDS. Mezaki, R.; Tilleux, E. W.; Jambois, T. F.; Margrave, J. L. (Univ. of Wisconsin, Madison; Rice Univ., Houston, Tex.). pp 138-45 of Advances in Thermophysical Properties at Extreme Temperatures and Pressures. New York, The American Society of Mechanical Engineers, 1965.

A copper-black drop calorimeter was utilized for the determination of high-temperature enthalpy increments for several refractory compounds (AlN, TaC, ZrC, CeO_2, CdO, MoO_2, $CaZrO_3$, CeS, CdS, $TaSi_2$, WSi_2, $MoSi_2$, and CdTe). The data are combined with low temperature data and correlated with other available high temperature data for the preparation of tables of thermodynamic functions over the range 0-1200°K. High-temperature thermodynamic data for a variety of refractory compounds, including AlN, TaC, ZrC, CeO_2, CdO, MoO_2, $CaZrO_3$, CeS, CdS, $TaSi_2$, WSi_2, $MoSi_2$ and CdTe, were obtained by drop calorimetry as a continuation of a program for the determination of thermodynamic properties of inorganic substances. Data are tabulated. (auth)

7116 A CALORIMETRIC DETERMINATION OF THE ENTHALPY OF GRAPHITE FROM 1200 TO 2600°K. West,

E. D.; Ishihara, S. (National Bureau of Standards, Washington, D. C.). pp 146-51 of Advances in Thermophysical Properties at Extreme Temperatures and Pressures. New York, The American Society of Mechanical Engineers, 1965.

Measurements are reported of the increase in the enthalpy of high-purity graphite between room temperature and 1200 to 2600°K. A new apparatus is described briefly. Methods of operation are developed which eliminate some systematic and random errors and are especially advantageous at high temperatures. The enthalpy data fit the equation $H_T - H_{298.15} = 28.9004T - 1.045 \times 10^{-4} T^2 - 16{,}126.2 \log_{10} T/313.15 - 8907.3$ where H is in absolute joules per gram atomic weights and T in degrees Kelvin. (auth)

7117 THERMODYNAMIC PROPERTIES OF NIOBIUM FROM 0°K TO THE MELTING POINT, 2740°K. Kirillin, V. A.; Sheindlin, A. E.; Chekovskoi, V. Ya.; Zhukova, I. A. (Inst. of High Temperatures, Moscow). pp 152-5 of Advances in Thermophysical Properties at Extreme Temperatures and Pressures. New York, The American Society of Mechanical Engineers, 1965.

Recent experimental data were used to formulate the thermodynamic properties of niobium over the full range of its existence in the solid state. The results of the formulation are tabulated. (auth)

7118 THE INFLUENCE OF A MAGNETIC FIELD ON THE VISCOSITY AND OTHER TRANSPORT PROPERTIES OF GASEOUS DIATOMIC MOLECULES. Beenakker, J. J. M.; Hulsman, H.; Knaap, H. F. P.; Korving, J.; Scoles, G. (Kamerlingh Onnes Lab., Leiden). pp 216-20 of Advances in Thermophysical Properties at Extreme Temperatures and Pressures. New York, The American Society of Mechanical Engineers, 1965.

A survey is given of the Leyden experimental work on the effects of magnetic fields on the viscosity and other transport properties of gaseous diatomic molecules. Data are given for O_2, CO, N_2, H_2, D_2, and HD. (P.C.H.)

7119 LIQUID-SOLID MIXTURES OF HYDROGEN NEAR THE TRIPLE POINT. Mann, D. B.; Ludtke, P. R.; Sindt, C. F.; Chelton, D. B. (National Bureau of Standards, Boulder, Colo.). 21p. (CONF-650802-9). ORINS. Gmelin, AED-CONF-65-193-1.

From Cryogenic Engineering Conference, Houston, Tex.

Properties and characteristics of liquid-solid mixtures of hydrogen, including production methods, solid particle size distribution, aging effects, and terminal velocities of the solid particles in the liquid melts, are discussed. The equipment and techniques for observation and measurements are described. The equipment developed and the results described are part of an effort to determine techniques and parameters pertinent to the study of production, storage, and pipe line transport of this upgraded fuel. (auth)

7120 A METHOD FOR GRANULATING AN ION-EXCHANGE SUBSTANCE CONSISTING OF FERRI- OR FERROCYAN METAL SALTS. Sumitani, Shozo (to Ebara Mfg. Co., Ltd.). Japanese Patent 1964-17255. Aug. 20, 1964. Filed May 29, 1962.

A method is proposed for granulating an ion-exchange substance consisting of metal ferri- or ferrocyanates without losing its ability. A slurry of this salt is precipitated by reacting with one or more of iron, copper, nickel, cobalt and zinc salts in amount below equivalence in their aqueous solution. This slurry is coagulated with a high-polymer coagulator added with bentonite, etc. It is then frozen and dissolved in an organic acid or salt solution. Finally, the substance is dehydrated and granulated. (NSA of Japan)

Organic Chemistry

Refer also to abstract 8012.

7121 THE SYNTHESIS OF 5-AMINOLEVULINIC-(5-^{14}C) ACID AND 4,5-DIOXOVALERIC-(5-^{14}C) ACID. Gnuchev, N. V.; Neiman, L. A.; Poznanskaya, A. A. (Inst. of Radiation, Physics, and Chemical Biology, Moscow). Biochemistry (USSR)(Engl. Transl.), 30: 138-40(Jan.-Feb. 1965).

Translated from Biokhimiya, 30: 161-4(Jan.-Feb. 1965).

The synthesis of 4,5-dioxovaleric-(5-^{14}C) and 5-aminolevulinic-(5-^{14}C) acids is described. 4,5-Dioxovaleric acid was isolated in pure form for the first time. (auth)

7122 THE ESR SPECTRA OF RADICAL ANIONS OF 1,6-BRIDGED CYCLODECAPENTAENE. Gerson, F. (Eidgenoessiche Technische Hochschule, Zurich); Heilbronner, E. Boell, W. A.; Vogel, E. Helv. Chim. Acta, 48: 1494-1512(Oct. 30, 1965). (In German).

The ESR spectra of the radical anions of 1,6-methanocyclodecapentaene and of 1,6-oxido-cyclodecapentaene, as well as of some of their deutero-derivatives, are reported. The observed spin populations are in essential agreement with the predictions derived from a simple HMO-model, if the electron repelling effect of the bridging groups is included. The reduced width of the spectra may be due to direct leakage of the unpaired electron into the CH-σ-orbitals, as a consequence of the breakdown of σ-π-orthogonality in the non-planar π-electron systems. (auth)

7123 SCINTILLATION AND PURITY OF TOLUENE GELIFIED BY ALUMINIUM OCTOATE. Serres, A.; Godeau, A.; Commanay, L. (Faculte Mixte de Medecine et de Pharmacie, Toulouse). J. Radiol., Electrol. Med. Nucl., 46: 491-4(Aug.-Sept. 1965). (In French).

The influence of a gelifying substance, of the chemical purity of the toluene, and of the presence of dissolved oxygen on the pulse heights of a scintillator of toluene gelified by aluminum octoate. This pulse height was not modified in a notable manner by the chemical impurities contained in commercial toluene. An exponential decrease was noted as a function of the concentration of the gelifying substance, but it appeared that this was but an effect of optic absorption. The pulse height increased by about 30% after elimination of the oxygen dissolved in the toluene. Oxygen acted as a scintillation inhibitor. (auth)

7124 THE HYDROGENATION AND EXCHANGE OF ETHYLENE OVER URANIUM HYDRIDE [Thesis]. Felter, Richard Earl. University Park, Pa., Pennsylvania State Univ., 1964. 105p.

Both ethylene and ethylene-hydrogen mixtures were used as gas phase reactants, and a tritium tracer was used to follow the hydrogen exchange reaction. Reaction of ethylene with UH_3 at 24°C resulted in instantaneous irreversible adsorption of about 35% of the saturation value. This adsorption reached saturation after 71 hr with a total adsorption equal to 17.7×10^{16} molecules/mg UH_3. The adsorbed species were identified as 68% C_2H_2 and 32% C_2H_4 with the relative amount of the latter increasing as the surface approached saturation. Use of tritium as a tracer component of the UH_3 showed that exchange of ethylene took place simultaneously with adsorption. The rate of exchange was greatly reduced on the poisoned surface but persisted even after the surface was saturated. Hydrogenation was studied at 24°C using gas mixtures of ethylene (29.4-132 mm Hg) and hydrogen (31.4–126 mm Hg). The reaction order was zero with respect to hydrogen gas pressure and 0.5 with respect to ethylene. Use of tritium tracers indicated that ethylene did not exchange during hydrogenation. A reaction mechanism was proposed, which involved both a Rideal and Langmuir-Hinshelwood type process in the overall reaction sequence. Two types of initial ethylene adsorption were postulated, a two-point associative irreversible adsorption and a one-point associative reversible adsorption. These two types of adsorbed species can react on the surface to form ethyl radicals. These in turn form ethane in the slow step by reaction with surface hydrogen. Exchange of ethylene with UH_3 takes place by way of the reversibly adsorbed ethylene. (Dissertation Abstr.)

Radiation Chemistry

See also BIOLOGY AND MEDICINE — Radiation Effects on Biochemicals Radiation Effects on Tissues

Refer also to abstracts 7381, 7390, 7475, and 7559.

7125 (BMI–1745, Sect. H) RADIOISOTOPE AND RADIATION APPLICATIONS. Kircher, J. F. (Battelle Memorial Inst., Columbus, Ohio). 2p.

Progress in the study of the effect of water on the radio-induced reaction of tin and 1-bromobutane is reported. (W.L.G.)

7126 (LFEN-27) RENDIMENTOS DE FORMACAO DE H_2O_2 NA IRRADIACAO DE SOLUCOES DE ACIDO SULFURICO COM PARTICULAS α DE 5.3 Mev. (The Yield of H_2O_2 Produced by Irradiation of Sulfuric Acid Solutions by α Particles at 5.3 Mev). Mariano, Maria Helena (Laboratorio de Fisica e Engenharia Nucleares, Junta de Energia Nuclear, Sacavem (Portugal)). 1964. 10p. (CONF-640711-2). Dep. mn.

From 27th Portugo-Spanish Conference on Progress in Sciences, Bilbao, Spain.

The yields of H_2O_2 in aerated solutions of 5×10^{-3} to 2.5 M H_2SO_4 irradiated with 5.3-Mev α particles of ^{210}Po were measured. The range of doses used was 0.28×10^{18} to 1.38×10^{18} ev/cm^2. For $[H_2SO_4] < 5.10^{-2}$ M, $G(H_2O_2)$ increased linearly with $[HSO_4^-]^{\frac{1}{2}}$; in the interval 5×10^{-2} M < $[H_2SO_4] < 10^{-1}$ M, $G(H_2O_2)$ remained constant whereas for concentrations higher than 10^{-1} M the yield was a decreasing linear function of the $\frac{1}{3}$ power of the HSO_4^- concentration. In order to interpret these results, the interference of sulfuric acid in the mechanism of water radiolysis is considered. (tr-auth)

7127 (NP-15539) REAKTIONEN ZWISCHEN PHOSPHORTRICHLORID UND OLEFINEN UNTER DEM EINFLUSS VON GAMMA-STRAHLUNG UND VON WAERME [These]. (Reaction Between Phosphorus Trichloride and Olefins Under the Influence of Gamma-Rays and Heat [Thesis]). Wunder, Klaus (Technische Universitaet, Berlin (West Germany)). 1965. 70p. Dep. mn.

Radioinduced reactions between phosphorus trichloride and olefin hydrocarbons were studied. The effect of γ radiation on mixtures of phosphorus trichloride and cyclohexene or hexene-1 formed 1-chlorcyclohexyl phosphorus dichloride or 2-chlorhexyl phosphorus dichloride by a Kharasch chain reaction mechanism. Under optimum conditions 100 to 2000 ev yields can be obtained. This method is suitable for the preparation of compounds. The G value is proportional to the reciprocal square root of the dose output and attains in both cases a maximum in 100°C in mixtures of 30 vol % olefin and 70 vol % phosphorus trichloride. For the activation energy of the velocity-determining steps $PCl_2C_6H_{i0} + PCl_3 \rightarrow PCl_2C_6H_{10}Cl + PCl_{\frac{1}{2}}$ or $PCl_2C_6H_{i2} + PCl_3 \rightarrow PCl_2C_6H_{12}Cl + PCl_{\frac{1}{2}}$ values of 7 or 6.6 kcal/mole were found. At high temperatures, the yield decreases sharply since another chain reaction predominates, through which cyclohexyl phosphorus dichloride or n-hexyl phosphorus dichloride was formed. Both chains have a common growth step. A reaction scheme was formulated that clarifies the details of the reactions. (tr-auth)

7128 (NYO-2206-1) COLOR-FORMING DOSIMETERS FOR IONIZING RADIATION. Final Report. Oster, Gerald (Polytechnic Inst. of Brooklyn, N. Y.). Dec. 13, 1965. Contract AT(30-1)-2206. 92p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Information is given on: thiolated gelatin as a model biological substrate; organic phosphorescent materials; environmental factors in luminescence and photoconductivity of zinc oxide; zinc oxide-sensitized photochemical reduction and oxidation; zinc oxide-sensitized photopolymerization; dye-sensitization and desensitization in zinc oxide photoconductivity; and zinc oxide as a radiation dosimeter. (P.C.H.)

7129 (NYO-2499-17) EFFECTS OF MERCAPTANS AND DISULFIDES ON PHOTOCHEMICAL AND HIGH ENERGY RADIATION INDUCED REACTIONS. Progress Report, November 1, 1964–November 1, 1965. Cohen, Saul G. (Brandeis Univ., Waltham, Mass. Dept. of Chemistry). Nov. 1, 1965. Contract AT(30-1)-2499. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Developments are reported for studies on: effects of mercaptan on photoreduction of benzophenone in ethers; photoreduction of 4-benzoylphenyltrimethylammonium chloride; photoreduction of aminobenzophenones; and effects of phenyl disulfide on flash photolysis of benzophenone in 2-propanol. (P.C.H.)

7130 (SGAE-CH-23/1965) DIE REAKTORRADIOLYSE VON TERPHENYLEN. (The Reactor Radiolysis of Terphenyl). Proksch, E.; Wiesinger, F.; Szinovatz, W.; Eschweiler, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). [1965]. 20p. Dep.

The radiolytic decomposition of an isomeric terphenyl mixture was measured using two different positions of the pool-type reactor ASTRA (fast neutron dose fraction 50.4% and abt. 23%, respectively). The measured values were used to evaluate by extrapolation the radiolytic action of both, pure gamma radiation and fast neutrons. For the temperature range of 275–350°C average values were: $G_h^0(\rightarrow HB) = 0.158$ or 0.151; $G_n^0(\rightarrow HB) = 0.278$ or 0.333; $G_h^0(Gas) = 0.0139$ or 0.0112; and $G_n^0(Gas) = 0.096$ or 0.104. Accuracy and significance of these values are discussed. Furthermore, radiolytic gas compositions and the effects of oxygen on radiolysis were determined. (auth)

7131 CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS IN INORGANIC SOLIDS. Harbottle, Garman (Brookhaven National Lab., Upton, N. Y.). Ann. Rev. Nucl. Sci., 15: 89-124(1965). (BNL-9069).

An attempt is made to review the trends of experimental work in the hot-atom chemistry of inorganic solids of roughly the past decade. A historical survey is given, followed by a consideration of the different nuclear reactions which have been used and their probable immediate results in terms of recoil energy or electronic disturbance. Recoil and post-recoil reactions in oxyanion, complex-ion, alkali halide and other inorganic crystals are then treated. Finally, the application of physical techniques to hot-atom problems is briefly discussed. (L.B.S.)

7132 RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. Hart, Edwin J. (Argonne National Lab., Ill.). Ann. Rev. Nucl. Sci., 15: 125-50(1965).

Significant advances in the identification of species, and clarification of the chemical processes taking place in irradiated water are surveyed which are attributed to worldwide activity in radiation chemistry and to the application of new experimental methods involving pulse radiolysis, refined analytical techniques, and the use of computers. The main emphasis is placed on the properties and reactions of the hydrated electron (e_{aq}^-), hydrogen atom, and hydroxyl radical generated by ionizing radiation. (L.B.S.)

7133 X-RAY INDUCED CONDUCTION IN n-HEXANE AT LOW STRESS. Secker, P. E.; Lewis, T. J. (Univ. of London). Brit. J. Appl. Phys., 16: 1649-56(Nov. 1965).

By means of a new technique for injecting charge into a dielectric liquid, conduction current and mobility values were measured in n-hexane for stresses over the range 0–7 kv cm^{-1}. At low stress (<1 kv cm^{-1}) the induced conduction current is shown to be space-charge-limited, but for higher stress values, the x-ray dose rate principally determines the magnitude of the current. The values obtained for both positive and negative ion mobility are considerably greater than those reported previously; it is postulated that this result arose as a result of current-induced motion of the liquid. (auth)

7134 CHEMICAL EFFECTS OF THE NEUTRON IRRADIATION OF ORGANIC COMPOUNDS CONTAINING FLUORINE. Ledrut, J. H. T.; Point, J. J. (Centre de la Faculte Polytechnique, Mons, Belg.). Bull. Cli. Sci., Acad. Roy. Belg. (5), 51: 56-65(1965). (In French).

It is shown theoretically that ^{18}F formed by the (n,2n) reaction with ^{19}F leaves the molecule to which the ^{19}F atom belonged. There is no retention. This conclusion was confirmed experimentally in solutions of C_6H_5F in C_2H_5OH; the retention in the form of C_6H_5F was proportional to the molar fraction of C_6H_5F. The divergence between this result and those reported in the literature is discussed. (tr-auth)

7135 REMARKS ON THE TECHNIQUES UTILIZED FOR THE DETERMINATION OF THE CHEMICAL CONSEQUENCES OF NUCLEAR REACTIONS. Ledrut, J. H. T.; Point, J. J. (Centre de la Faculte Polytechnique, Mons, Belg.). Bull. Cl. Sci., Acad. Roy. Belg. (5), 51: 66-75 (1965). (In French).

A study was made of techniques proposed in the literature for study of the chemical consequences of nuclear reactions. The divergences between the values of total organic retention reported in the literature and the controversies concerning the eventual existence of isometric and isotopic effects can be explained, at least in part, by the use of unsatisfactory experimental techniques. (tr-auth)

7136 EFFECTS OF γ RAYS ON PYRIMIDIC BASES IN THE SOLID STATE. I. EFFECTS ON URACIL AND THYMINE. Nofre, Claude; Bobillier, Pierre; Chabre, Marc; Cier, Andre (Centre de Recherches du Service de Sante des Armees, Lyon). Bull. Soc. Chim. France, No. 10, 2820-4(Oct. 1965). (In French).

Uracil irradiated in the solid state by γ rays at a dose of 10^9 rad was more stable than thymine; among the products formed, cyclodimers were identified from both compounds and 5-hydroxymethyluracil was identified in the degradation products of thymine. (tr-auth)

7137 ELECTRON SPIN RESONANCE STUDIES OF THE HYDROXYL RADICAL IN γ-IRRADIATED ICE. Brivati, J. A.; Symons, M. C. R.; Tinling, D. J. A.; Wardale, H. W.; Williams, D. O. (Univ. of Leichester, Eng.). Chem. Commun., No. 17, 402-3(Sept. 8, 1965).

The electron spin resonance spectra at X- and Q-band of gamma-irradiated powders and single crystals of ice and ice-d_2 at 77°K were studied. Dilute solutions of radicals thought to be hydroxyl were prepared in crystals consisting largely of deuterium oxide in order to reduce the widths of the proton hyperfine lines. These hyperfine lines then appeared as relatively narrow satellites on either side of the triplet assigned to OD. The anisotropic hyperfine coupling was calculated. (M.C.G.)

7138 SELF-DECOMPOSITION OF ^{14}C-LABELED ORGANIC COMPOUNDS. Rochlin, Phillip (Picatinny Arsenal, Dover, N. J. Naval Propellant Plant, Indian Head, Md.). Chem. Rev., 65: 685-96(Dec. 1965).

The self-degradation of organic compounds containing ^{14}C is reviewed. The effects of substituent groups on radiation stability were studied. Data are presented on the effects of the following groups: nitro, nitrile, nitroso, sulfonic acid, and hydroxylamine groups and quinones. The effects of impurities on radioinduced changes, labeled organic compound are discussed. The primary (internal) radiation effect, the secondary radiation effect, and the chemical effect are discussed. A procedure for determining the amounts of radioactive decomposition products from self-decomposition is given. The per cent decomposition and the theoretical per cent decomposition are compared for various compounds. Methods of reducing the amount of self decomposition are discussed. (F.J.H.)

7139 RADIOLYSIS OF Co(III) AQUOCOMPLEXES. Neokladnova, L. N.; Shagisultanova, G. A. (Lenin Belorussian State Univ.). Dokl. Akad. Nauk SSR, 162: 1065-7(June 11, 1965). (In Russian).

A 0.005 or 0.001M solution of cis or trans $[Co\ en_2(H_2O)_2]Cl_3 \cdot H_2O$ and of $[Co(NH_3)_3(H_2O)_3](NO_3)_3$ was irradiated with ^{60}Co radiation. Changes in solution pH and molecular electrical conductivity were determined and tabulated. The pH of the solution increased with irradiation, while the electrical conductivity showed no trend. Co(II) was detected on irradiating the solutions. The radiation yields of Co(II) were: 1.2 mole/100 ev from $[Co(NH_3)_5H_2O]Cl_3$, 1.9 mole/100 ev from $[Co(NH_3)_4(H_2O)_2]Cl_3$, and 2.3 molecules/100 ev from $[Co(NH_3)_3(H_2O)_3](NO_3)_3$. The higher the NH_3 content of the aquoammonia complex, the lower the Co(II) yield. Co(II) was also found on irradiating the cis and trans $[Co\ en_2(H_2O)]Cl_3$ compounds. On irradiating the cis compound, the Co(II) yield was 1.31 mole/100 ev at a dose of 3×10^5 rads, 0.87 mole/100 ev at a dose of 7.5×10^5 rads, and 0.85 molecules/100 ev at a dose of 1×10^6 rads. The decrease in Co(II) yield with increasing dose is probably related to the increase in pH. The irradiated solutions possessed an increased catalytic activity in decomposing H_2O_2. (TTT)

7140 RADIATION-CHEMICAL OXIDATION OF POTASSIUM IODIDE IN SOLUTIONS SATURATED WITH NITROUS OXIDE. Brusentseva, S. A.; Dobrev, D. D.; Shubin, V. N.; Dolin, P. I. (Inst. of Electrochemistry, USSR Academy of Sciences, Moscow). Dokl. Akad. Nauk SSR, 162: 1083-5(June 11, 1965). (In Russian).

Solutions 0.05 to ~0.5M in KI, saturated with N_2O at atmospheric pressure, were irradiated with ^{60}Co gamma rays to a total dose of 2 to 8×10^{17} ev/cm^3. The yield of I_2 was constant at 3.00 ± 0.15 molecules/100 ev at a pH of 2.5 to 10, and decreased to a value of 0.4 ± 0.1 molecules/100 ev at a pH of 14. The decrease in yield was due to competition between the following reactions: $OH + OH^- \rightarrow O^-_{aq}$, and $I^- + OH \rightarrow I + OH^-$. If the reactions, $N_2O + H \rightarrow N_2 + OH$ and $N_2O + (e^- \cdot nH_2O) \rightarrow N_2 + OH + OH^-_{aq}$, are assumed in addition to the first two reactions, it is possible to plot the experimental data, and to obtain a value of $k_1/k_2 = 0.025 \pm 0.045$ for the rate constants of the first two reactions. The following G yields were obtained for a 0.05M KI solution at neutral pH: 3.15 for N_2, 0.40 for H_2, 0.22 for O_2, 0.53 for H_2O_2, and 4.37 molecules/100 ev for H_2O. (TTT)

7141 EFFECT OF ^{60}Co γ-RAYS ON POLYVINYL ALCOHOL. Bhardwaj, I. S.; Kaushal, P. K.; Patnaik, B. I.; Thampy, R. T. (Shri Ram Inst. for Industrial Research, Delhi). Indian J. Chem., 3: 511-12(Nov. 1965).

Polyvinyl alcohol on irradiation with ^{60}Co γ rays in the presence of air undergoes degradation with the conversion of the hydroxyl groups in the polyvinyl alcohol into carbonyl groups. A decrease in the intrinsic viscosity of the polymer solution is obtained with increased irradiation dosage, which indicates that the degradation of the polyvinyl alcohol molecule probably occurs by chain scission. (auth)

7142 EFFECT OF IRRADIATION ON ELECTRICAL CONDUCTIVITIES OF SOME COBALT CHELATES. Nath, Amar; Khorana, S.; Ramshesh, V.; Shankar, J. (Atomic Energy Establishment, Trombay, Bombay). Indian J. Chem., 3: 512-14(Nov. 1965).

Electrical conductivities of the two cobalt complexes, bis-salicylaldehyde-triethylene tetramine Co(III) chloride dihydrate and cobalt phthalocyanine, were measured in the presence and absence of oxygen. The former complex exhibited higher conductivity in the presence of oxygen. Measurements were also carried on irradiated samples. Irradiation of the complexes resulted in a considerable increase of conductivities, indicating the presence of fresh electronic levels in the forbidden zone. (auth)

7143 RADIATION INDUCED ABSORPTION IN $NaClO_3$ AND $KClO_3$ CRYSTALS. Ramasastry, C.; Sastry, S. B. S. (Indian Inst. of Tech., Madras). Indian J. Pure Appl. Phys., 3: 414-17(Nov. 1965).

A spectrophotometric study of the absorption characteristics of x-ray irradiated single crystals of $NaClO_3$ and $KClO_3$ was made and the effects of optical and thermal bleaching of the color centers were analyzed. The irradiated crystals were found to show absorption peaks at 228, 260, 310, 360, and 420 mμ in $NaClO_3$ crystals and at 216, 260, 310, 360, and 450 mμ in $KClO_3$ crystals. From a study of the observed characteristics of the absorption maxima of various radicals in aqueous solution, the 260, 310, and 360 mμ bands are ascribed respectively to ClO^-_2, ClO^-, and ClO_2, radicals formed in the crystals due to irradiation. It was found that these absorption bands could be optically bleached. The origin of the visible bands is discussed in the light of the observations made on optical and thermal bleaching effects and electron spin resonance data. (auth)

7144 YIELDS OF RADICAL IONS IN THE PULSE RADIOLYSIS OF LIQUID CYCLOHEXANE SOLUTIONS. Keene, J. P.; Land, E. J.; Swallow, A. J. (Christie Hospital, Manchester, Eng. Holt Radium Inst., Manchester, Eng.). J. Amer. Chem. Soc., 87: 5284-90(Dec. 5, 1965).

Experiments were performed to measure the yields of ions on radiolysis of a liquid hydrocarbon. Pulse radiolysis of nine different aromatic solutes in cyclohexane gave rise to transient spectra, some of which could be assigned to aromatic radical ions. It was not possible to distinguish whether the ion absorptions were due to anions or cations. Total radical ion yields were obtained using literature values for the extinction coefficients of anions or cations (assumed to be equal). For all the solutes used the sum

of anion and cation yields at concentrations up to 10^{-1}M were less than or equal to 0.6. These yields were consistent with those found in most previous experiments by other workers using different methods but were much lower than the yields implied by using N_2O as an electron scavenger. It may be that some of the ion pairs formed by radiation recombine in times much less than a microsecond. Such ions are not detected by pulse radiolysis or conductivity measurements, but in the N_2O experiments recombination is accompanied or preceded by measurable chemical effects. (auth)

7145 REACTIONS OF ENERGETIC CARBON ATOMS WITH AMMONIA. II. Cacace, Fulvio; Wolf, Alfred P. (Brookhaven National Lab., Upton, N. Y.). J. Amer. Chem. Soc., 87: 5301-8(Dec. 5, 1965). (BNL-9042).

Carbon atoms react with gaseous ammonia to give methane, methylamine, and methylenimine. Methylenimine and part of the methylamine are formed in reactions between carbon atoms with excess kinetic energy ("energetic") and ammonia. Most of the methane is formed in thermal reactions. Evidence for the formation of formaldoxime from the reaction between carbon atoms and ammonia–oxygen mixtures is presented. Facile radiolytic reduction of methylenimine and methylamine was demonstrated. The formation of hydrogen cyanide or any derivative thereof was not demonstrable under the reaction conditions. (auth)

7146 SOLUTE EFFECTS IN THE RADIOLYSIS OF CYCLOHEXANE SOLUTIONS. EFFECT OF SUBSTITUTED AROMATIC COMPOUNDS. Sherman, Warren (Army Natick Labs., Mass.). J. Chem. Soc., 5402-6(Oct. 1965).

The effects of monosubstituted aromatic compounds on the yields of hydrogen, cyclohexene, and bicyclohexyl formed in the γ radiolysis of liquid cyclohexane solutions were studied. The observed decrease in yields of all three products is discussed in terms of various processes proposed for radioinduced reactions. (auth)

7147 THE CHEMICAL EFFECTS OF γ-RADIATION ON ORGANIC SYSTEMS. PART XII. THE ADDITION OF TERTIARY AMINES TO ALKENES. Allan, L. T.; Swan, G. A. (Univ. of Newcastle upon Tyne, Eng.). J. Chem. Soc., 5704-7(Oct. 1965).

Gamma radiation effects on mixtures of tertiary amines and alkenes are discussed. The products and G values of products formed by irradiation of triethylamine–Oct-1-ene mixtures are given. Studies were also made of methylpiperidine–Oct-1-ene mixtures. (MCG)

7148 SOME KINETIC CHARACTERISTICS OF THE RADIOCHEMICAL POLYMERIZATION OF CRYSTALLIZED ACRYLAMIDE. Chapiro, Adolphe; Zumer, Maxime (CNRS, Bellevue, France). J. Chim. Phys., 62: 947-50 (Sept. 1965). (In French).

The radiochemical polymerization of acrylamide at 20°C was studied in a wide range of γ intensities. Self-accelerated conversion curves, which gave, in logarithmic scales, parallel lines with a slope of 2, were obtained. The instantaneous velocity verified the relation $V_{inst.} = K I^{0.5}$. Experiments made with monomeric crystals of different qualities showed that this parameter had only a weak effect on the reaction speed. It is shown that for a given conversion the higher the radiation intensity the lower the molecular mass. The molecular masses were much larger when the monomeric crystals were fused and recrystallized by rapid quenching before the irradiation. The radiolytic yield of the initiation, G (initiator center), was calculated from the velocities and the molecular masses. This yield varied from 1.1 to 2.5. It became larger as the intensity was decreased. (tr-auth)

7149 THE INFLUENCE OF STRUCTURE UPON THE RETENTION OF ^{82}Br IN SOME NEUTRON-IRRADIATED ORGANIC COMPOUNDS. Katsanos, N. A.; Varvoglis, A. G. (Nuclear Research Centre "Democritus", Aghia Paraskevi Attikis, Greece). J. Inorg. Nucl. Chem., 27: 2445-7(Nov. 1965).

Equimolar mixtures of bromobenzene and o-chlorophenol and of chlorobenzene and o-bromophenol were irradiated at 1.5×10^{10} n/cm^2/sec in the Greek reactor Democritus in a low gamma field for 15 min for each mixture except those containing CBr_4, which were irradiated for 1 hour. Bromophenol (^{82}Br) and o-$^{82}BrC_6H_4OH$ were formed in the substitution reactions (Szilard-Chalmers) which took place. Reduced retention was found when a 0.2M fraction of aniline was added as an electron donor. Experiments were also performed with tetrabromomethane as a source of radiobromine in mixtures of $PhNH_2$ and PhOH in various mole ratios. It is postulated that a charge transfer complex is formed between the ^{82}Br and the inactive halogen bound to the benzene ring, followed by replacement within the complex. (R.E.U.)

7150 ELECTRON CAPTURE BY SOLUTES IN THE RADIOLYSIS OF METHANOL AND ETHANOL. Hayon, E.; Moreau, M. (CEA, Saclay, France). J. Phys. Chem., 69: 4053-7(Dec. 1965).

The yields of hydrogen produced on γ irradiation of air-free methanol and ethanol at lowest doses are $G(H_2) = 5.25$ and $G(H_2) = 5.0$, respectively. Addition of certain salts ($NiCl_2$, $CoSO_4$) was used to determine the readily scavengeable yields of solvated electrons in methanol, $G(e^-) = 1.05$, and ethanol, $G(e^-) = 0.90$. Addition of nitrate and chloroacetate ions, over a wide concentration range, gave rise to a decrease in hydrogen yields and an increase in yields of nitrite and chloride ions. Above a certain solute concentration, the sum of the yields of $G(H_2) + G(NO_2^-)$ or $G(H_2) + G(Cl^-)$ increased with further increase in [S]. This increase is shown to be proportional to the rate constant of the solute with solvated electrons and is attributed to electron capture by solutes in the spurs leading to a decrease of the combination reaction $RCH_2OH^+ + RCH_2OH^- \rightarrow 2RCH_2OH$. The total scavengeable yield of electrons is $G(e^-) = 1.85$ in methanol and $G(e^-) = 1.65$ in ethanol. (auth)

7151 REACTION MECHANISM LEADING TO THE FORMATION OF MOLECULAR HYDROGEN IN THE RADIATION CHEMISTRY OF WATER. Hayon, E.; Moreau, M. (CEA, Saclay, France). J. Phys. Chem., 69: 4058-62(Dec. 1965).

The yields of molecular hydrogen from the γ radiolysis of air-free neutral solutions of potassium dichromate, potassium nitrite, and copper nitrate were measured over a very wide range of concentrations, such that up to 99% of the hydrogen was scavenged by these solutes. From a comparison of the scavenging efficiencies of the various solutes used, the results seemed to indicate the presence of two precursors leading to the formation of molecular hydrogen. From a kinetic treatment of the data it was assumed that the precursors are electrons and H atoms, which react according to $H_2O^- + H_2O^- \rightarrow H_2 + 2OH^-$ and $H + H_2O^- \rightarrow H_2 + OH^-$, with a small contribution from $H + H \rightarrow H_2$. On accounting for the different rate constants for reaction of the solutes with the two reducing species, it is possible to obtain better qualitative agreement between theoretical diffusion kinetics calculations and experiment. (auth)

7152 REACTIONS OF ALANINE WITH THE REDUCING SPECIES FORMED IN WATER RADIOLYSIS. Weeks, Boyd M.; Cole, Sibyl A.; Garrison, Warren M. (Univ. of California, Berkeley). J. Phys. Chem., 69: 4131-7(Dec. 1965). (UCRL-11988).

The effects of pH and added scavengers on the reactions of alanine with the reducing species formed in water radiolysis were studied. A principal reaction of the hydrated electron (e^-_{aq}) led to degradation of the N–C linkage, e.g., $e^-_{aq} + RNH_3^+ \rightarrow R + NH_3$. The rate of removal of e^-_{aq} by such reaction was strongly dependent on the ionic form of the α-amino acid; β-alanine was relatively less reactive toward e^-_{aq} under all conditions of pH. A suggested reaction scheme accounts both qualitatively and quantitatively for the observed effects of pH on product yields from oxygen-free solutions of alanine under γ rays. (auth)

7153 RECOIL TRITIUM REACTION: RING OPENING AND ALKYL REPLACEMENT IN SUBSTITUTED CYCLOPROPANES. Tang, Yi-noo; Rowland, F. S. (Univ. of Kansas, Lawrence. Univ. of California, Irvine). J. Phys. Chem., 69: 4297-4304(Dec. 1965).

In addition to the two common reactions of abstraction of and substitution for hydrogen atoms, energetic recoil tritium atoms react with substituted cyclopropanes by attack on the C−C bond with ring opening and the formation of an excited, tritium-labeled radical. These free radicals subsequently decompose both by C−C bond breakage to a smaller radical and an olefin and also by the higher activation energy process of loss of a hydrogen atom, in about equal yields. The replacement of alkyl groups substituted on the cyclopropane ring by energetic tritium atoms also occurs, and the excited methylcyclopropane-t and cyclopropane-t molecules so formed are sufficiently excited to undergo unimolecular isomerization. The higher yields of olefinic products from the ring-opening reaction obscure these isomerization reactions and prevent quantitative estimate of the energies of excitation involved in the substitution of an energetic tritium atom for an alkyl group. (auth)

7154 RADIATION GRAFTING OF VINYL MONOMERS TO WOOL. PART I. Stannett, V.; Araki, K.; Gervasi, J. A.; McLeskey, S. W. (Research Triangle Inst., Durham, N. C.). J. Polymer Sci. Pt. A, 3: 3763-79(Nov. 1965).

A number of vinyl monomers were grafted to wool by using the mutual radiation technique. Styrene was studied in considerable detail in dioxane solution; water or methanol was found to be necessary for successful grafting. It was believed that these compounds function as swelling agents, enabling the monomer to diffuse to the active centers created in the wool by the radiation. The rate of grafting always went through a maximum and then leveled off to a slower rate. This is believed to be due to the slow build-up of the radical population, leading eventually to a diffusion-controlled rate of grafting. Considerable post-polymerization grafting was found to take place. Acrylonitrile and a number of allyl monomers were also successfully grafted to wool by the mutual radiation method in dimethylformamide solution. Again water or methanol was found to be necessary; the grafting rate leveled off close to zero at a degree of grafting depending on the amount of swelling agent present. (auth)

7155 THE INFLUENCE OF WHITE PHOSPHORUS ON THE γ-RAY INDUCED POLYMERIZATION OF STYRENE. Drawe, H.; Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Makromol. Chem., 84: 203-12(1965). (In German).

When white phosphorus is exposed to high-energy radiation in the presence of organic compounds, it forms an end-group radical according to the reaction: $R\cdot + P_4 \rightarrow R\text{-}P_4$. To investigate the various chain reactions that can occur when styrene is present as the organic component, a solution of white phosphorus (3.3 to 0.95 at. %) in styrene was irradiated at 23°C with a ^{60}Co source. The results showed that white phosphorus slightly accelerated the γ-initiated polymerization of styrene. The average molecular weight of the polystyrene was nearly independent on the dose rate and decreased with increasing concentration of white phosphorus. The rate of polymerization was proportional to the square root of the dose rate. The amount of incorporated phosphorus linearly increased with the concentration of white phosphorus. It amounted to about 10^{-2} atoms per monomer unit at $[P_4] = 0.95$ g at./l (saturated solution). P-P bonds were not present in the main chain or end groups of the polystyrene as shown by chlorination experiments. Kinetic aspects of the polymerization of styrene in the presence of white phosphorus are described by a telomerization mechanism. According to this mechanism, the white phosphorus scavenges growing chains of styrene and starts new ones with a transfer constant of 0.04. (BBB)

7156 ELECTRON SPIN RESONANCE OF THE $N_2O_2^+$ RADICAL. Muniz, R. P. A.; Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil). Mol. Phys., 9: 599-600(1965).

Evidence was found for the existence of the $N_2O_2^+$ radical in the EPR spectrum of electron irradiated sodium nitroprusside. The spectrum is shown, and the g-values and hyperfine splittings are tabulated. (L.B.S.)

7157 THE SCINTILLATION DECAY OF SOME COMMERCIAL ORGANIC SCINTILLATORS. Sjoelin, P. G. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods, 37: 45-50(Nov. 1965).

The scintillation decay of some commercially available organic scintillators is studied on the interval 0 to 100 nsec by a delayed coincidence method. Measurements indicate that on the investigated time interval the scintillation decay of most organic scintillators contains two exponential components, the longer decay time being dependent on the ionization density produced by the exciting radiation. The results are compared with theoretical models. (auth)

7158 DIRECTIONAL ANISOTROPY IN THE CHARACTERISTICS OF THE ORGANIC-CRYSTAL SCINTILLATORS. [PART] II. Tsukada, K.; Kikuchi, S.; Miyagawa, Y. (Japan Atomic Energy Research Inst., Tokyo). Nucl. Instrum. Methods, 37: 69-76(Nov. 1965).

The directional anisotropy in the scintillation response of anthracene and p-terphenyl crystals for fast neutrons is measured in an energy range of 0.3 to 16 Mev. The anisotropy appears to have close correlations with directions of the molecular long axes (or the optical principal Z axis) and the crystallographic b axis. For the anthracene crystal, the molecular long axes correspond to the maximum scintillation response (though the direction of the maximum response changes with the neutron energy by about 30° in the above energy range) and the b axis to the minimum response. For the p-terphenyl crystal, the direction of the molecular long axes coincides approximately with that of the minimum response, and the optical principal X axis, (which is perpendicular to both of the molecular axes and b axis) coincides with the direction of the maximum response. An analysis for the energy dependence of the directional anisotropy of the anthracene crystal shows that the anomalous response can be explained by directional variations of a quenching term. The maximum variation of the quenching term amounts to 40%. (auth)

7159 INFLUENCE OF β-RAYS AND γ-RAYS ON THE DISCHARGE CURRENT IN CHLORINE UNDER OZONIZER EXCITATION. Venugopalan, M. (Royal Military Coll. of Canada, Kingston, Ontario). Nuovo Cimento (10), 40B: 375-82(Dec. 11, 1965).

Irradiation with β or γ rays of a low-frequency electric discharge in chlorine produces changes in the discharge current analogous to the Joshi effect. Large positive effects occur on irradiation with γ rays, whereas the negative effect is large on irradiation with visible light, where the Joshi effect varies linearly with the light frequency. Irradiation with β or γ rays of any part of the discharge produces these effects, in contrast to the Joshi effect which is produced by illuminating the electrode regions alone. For a given minimum intensity and frequency of the external radiation, the effect is positive at low applied potentials. It first increases with potential, and then decreases to become negative at large potentials. For a given potential, the positive and negative effects increase with the intensity of β or γ rays, more rapidly at low than at high intensities, where they exhibit a saturation effect. In some cases, and especially depending on the applied potential, a reversal in sign of the effect occurs when the intensity of the β or γ rays is varied. It appears that the positive effect observed on irradiation with β or γ rays is due to enhanced ionization at low electric fields, while the negative effects is caused by the space-charge dependence on the magnitude of the potential and the intensity of radiation. (auth)

7160 SOME TRAPPING CENTERS IN NaI(Tl) CRYSTALS. Baturicheva, Z. B.; Gurevich, N. Yu.; Tsirlin, Yu. A. Opt. Spectros. (USSR)(Engl. Transl.), 19: 136-8 (Aug. 1965).

Translated from Opt. Spektros., 19: 242-6(Aug. 1965).

Thermoluminescence, thermo-optical luminescence, and induced absorption were studied in x-rayed NaI(Tl) crystals. The measurements indicated that x-ray irradiation of NaI(Tl) crystals containing about 0.1 wt % Tl at room temperature causes a reduction in the absorption of the dual thallium centers. Consequently, this leads to the formation

of dual thallium trapping centers. It is shown that these trapping centers compete with trapping centers formed by thermal microdefects in the lattice in the trapping of electrons at temperatures higher than room temperature. (M.C.G.)

7161 GROWTH OF ABSORPTION BANDS IN CaF_2 CRYSTALS UNDER PROTON IRRADIATION. Lisitsyna, L. A. Opt. Spectros. (USSR)(Engl. Transl.), 19: 167-8 (Aug. 1965).

Translated from Opt. Spektros., 19: 295-6(Aug. 1965).

An investigation was made of the kinetic growth curves of the absorption bands in natural and synthetic CaF_2 crystals. The samples were irradiated by 4.2-Mev protons and their absorption spectra measured. The absorption spectra of the irradiated crystals consisted of four absorption bands with maxima at 580, 400, 335, and 225 nm. The 400 and 335 nm bands had a tendency toward saturation as the radiation dose increased. The initial rapid increase in the accumulation curve for the 580-nm band is assumed to be caused by the process of filling, with electrons or vacancies, the defects existing before irradiation, with the formation of centers responsible for the 580-nm absorption band. The linear portion is apparently associated with the generation of new defects and the localization of electrons or vacancies on them. (M.C.G.)

7162 THE INFLUENCE OF SMALL AMOUNTS OF EXCITATION ACCEPTOR ON RADICAL FORMATION IN THE γ-RADIOLYSIS OF n-HEXANE. Polak, L. S.; Shcherbakova, A. S. (Inst. of Petroleum Chemical Synthesis, Academy of Sciences, USSR). Petrol. Chem. (USSR) (English Transl.), 2: 228-31(1963).

Changes in the concentration of hexyl radicals were determined by the EPR method in the radiolysis of n-hexane at 77°K in the presence of small amounts of benzene, and the influence of the same additive on the yield of hydrogen, hexene, the C_2-C_4 gas fraction, and on the overall yield of C_8-C_{12} fraction in radiolysis at 300°K were also investigated. The results showed that the excitation acceptor abstracts excitation energy from the molecules (or ions) of the alkane before the chemical reaction stage, and that the inhibition with respect to hydrogen is a linear function of the $\frac{2}{3}$ power of the concentration of the acceptor. The yield of radiolysis products with a number of carbon atoms greater than that of the alkane subjected to radiolysis was assumed to follow the same law. These products were obtained mainly by the recombination of alkyl radicals (obtained by rupture of C–H and C–C bonds). To verify this assumption, a chromatographic study was made of the C_9-C_{12} products of the ^{60}Co γ radiolysis of n-hexane in the presence of small amounts of benzene. Results indicated that the yield of the product of recombination of the various radicals (C_9-C_{12} saturated hydrocarbons) diminishes to ~23%, according to the concentration of additive. The dependence of the yield of these products on the concentration (c) followed the law $1/G = f(c^{\frac{1}{3}})$. The composition of the C_9-C_{12} fraction and the composition of the dimeric C_{12} product was the same when n-hexane was subjected to radiolysis in the pure state and in the presence of various amounts of benzene. The radiation acceptor (benzene) abstracted energy from the electronic levels of the excited molecules before the chemical process of radical formation or other chemical reactions of the molecules or ions began. (BBB)

7163 THE EFFECT OF CHLORIDE IONS ON SOME RADIATION CHEMICAL REACTIONS IN AQUEOUS SOLUTION. Ward, J. F.; Myers, L. S. Jr. (Univ. of California, Los Angeles). Radiat. Res., 26: 483-92(Dec. 1965). (UCLA-12-548).

The different reaction specificities of Cl and OH radicals were used to determine the conditions necessary for chlorine atom production. Thymine and ethanol competed for OH· free radicals. In the presence of sodium chloride in acid solution, the OH· radical was converted to a different species which reacts preferentially with thymine. By varying the pH and chloride ion concentration independently, it was found that the conversion depends on both quantities and apparently follows third-order kinetics with a rate constant of 7.6×10^9 liter^2 mole^{-2} sec^{-1} for the reaction $OH\cdot + Cl^- + H^+ \rightarrow Cl\cdot + H_2O$. (H.G.D.)

7164 ON THE ABILITY OF NITROUS OXIDE TO CONVERT HYDRATED ELECTRONS INTO HYDROXYL RADICAL. Nakken, Karl Ford; Pihl, Alexander (Norsk Hydro's Inst. for Cancer Research, Oslo). Radiat. Res., 26: 519-26(Dec. 1965).

The nature and reactivity of the oxidizing entity formed when nitrous oxide scavenges hydrated electrons was studied by measuring the effect of nitrous oxide on the radioinduced degradation of p-aminobenzoic acid and of pyridoxal-5-phosphate at pH 7.4. In the presence of nitrous oxide, pyridoxal-5-phosphate was degraded with a G value twice that found in oxygen. The results show that N_2O converts e^-_{aq} into an oxidizing species, which, in this system, is stoichiometrically equivalent to the OH radical. The hydroxylation and degradation of p-aminobenzoic acid, effected by OH radicals exclusively, were increased by nitrous oxide in the absence of oxygen to the same extent as by the electron scavenger nitrate. In a mixture of 20% oxygen and 80% N_2O the degradation was the same as in pure oxygen. The results can be accounted for by the fact that N_2O removes e^-_{aq}, thus interfering with the back-reactions that otherwise reduce the yield of degradation of p-aminobenzoic acid. The results indicated that, at neutral pH, N_2O^- does not decompose spontaneously to OH radicals at any appreciable rate. It is suggested that N_2O^- radicals may have an appreciable lifetime at neutral pH and that this radical is less reactive than OH radicals, but more reactive than O_2^- and potassium nitrosodisulfonate radicals. (auth)

7165 DETERMINATION OF THE YIELD OF RADIATION-CHEMICAL RECOMBINATION OF TRYPTOPHAN AND GUANINE BY MEANS OF MATHEMATICAL ANALYSIS OF ABSORPTION SPECTRA OF SOLUTIONS. Granovskaya, M. L.; Grinev, V. S.; Duzhenkova, N. A.; Krushinskaya, N. P.; Savich, A. V. Radiobiologiya, 5: 633-7 (1965). (In Russian).

Solutions 2.5×10^{-4} molar in tryptophan were irradiated at a pH of 7 with ^{60}Co gamma radiation at doses of 5, 10, 20, 50, and 100 krads. The solution absorption spectrum was found to be due to that of a 3-component mixture of tryptophan, kynurenine, and anthranilic acid after subtracting a contribution from 3-indolacetic acid. The initial G yields were found to be 0.36 ± 0.07 for the production of kynurenine, 1.02 ± 0.2 for the production of anthranilic acid, and 3.3 ± 0.2 for the disappearance of tryptophan. The radiolytic products of guanine are unknown, but the irradiated solution can be treated as a two-component system. The G yield for the disappearance of guanine was found to be 1.32 ± 0.05. (TTT)

7166 FORMATION OF PEROXIDES BY RADIOLYSIS OF SOME PREDECESSORS OF NUCLEIC ACIDS. Krushinskaya, N. P. Radiobiologiya, 5: 645-51(1965). (In Russian).

The following nitrogen bases were studied: orotic acid, uracil, thymine, cytosine, guanine, and their nucleosides: desoxyuridine, thymidine, desoxycytidine, desoxyguanosine, and desoxyadenosine. The concentration in all cases was 3×10^{-2}M with the exception of guanine and desoxyguanosine where the concentrations were 7×10^{-5} and 5×10^{-4}M, respectively. The irradiated solutions were analyzed to determine the yield of organic peroxide, the yield of H_2O_2, and the disappearance of the chromophoric group on the nitrogen base. With orotic acid the G-value for the formation of H_2O_2 was high (3.5 molecules/100 ev), while no organic peroxide could be detected. The G-value for the formation of organic peroxide was 0.7 for uracil, and only 0.4 molecules per 100 ev for desoxyuridine. The corresponding G-values were 1.4 and 0.8 for thymine and thymidine. The yield of organic peroxide was a factor of two less in the nucleoside than in the corresponding base due to a competing reaction of the HO_2 and OH radicals with the carbohydrate part of the nucleoside. The values for the disappearance of the chromophoric group were lower in the nucleosides than in the corresponding bases. The

imidazole ring protected against breakdown of the chromophoric group. (TTT)

7167 REACTION OF ^{14}C RECOIL ATOMS IN MIXTURES CONTAINING α-PICOLINE. Barakat, M. F.; Firsova, L. P.; Nesmeyanov, An. N. Radiokhimiya, 7: 361-3(1965). (In Russian).

The marked deviations from the additive law, noted in reactions of recoil atoms in binary mixtures, were ascribed to the stabilization of excited molecules or to the effect of competing reactions, such as thermal diffusion–recombination effects. In order to clarify the effect due to the type of component molecule on the reaction of ^{14}C recoil atoms in heterocyclic compounds, the radiochemical reactions in binary mixtures containing α-picoline were closely examined. The following compounds were used as the second component of the system: aniline, toluene, 1,1-diphenylpicrylhydrazyl (DPPH), piperidine, and 3,5-dimethylpyrazole (DMP). The mixtures were exposed to a neutron flux of 0.87×10^{13} n/cm^2 · sec for 200 hours. By means of combustion analysis and gas-liquid chromatography the total activity and that of the gaseous, liquid, and polymer fractions were determined. The results showed that mixtures containing picoline and DPPH exhibited the highest deviation, together with variations in the distribution of activity between the various fractions; the increasing yield of high-boiling products was accompanied by the nearly complete disappearance of materials with boiling points below 180°C. The additive law of the yield of most of the labeled compounds was not violated in mixtures containing picolene and DMP or piperidine; no marked deviations were observed in systems containing aniline or toluene. (TTT)

7168 MOLECULAR MOTIONS AND TRANSITIONS IN IRRADIATED ISOTACTIC POLYSTYRENE. Butta, Enzo; Frosini, Vitorio (Univ., Pisa, Italy. Centro Nazionale per la Chimica delle Macromolecole (CNR), Pisa, Italy). Ric. Sci. Rend., Sez. A, 6: 5-16(Oct. 1964). (In Italian).

The effects of gamma rays and neutrons on the dynamic-mechanical properties and structure of isotactic polystyrene were investigated. Young's modulus and the damping factor at various temperatures from –180 to 250°C were determined in some irradiated samples by an electrostatic method at middle frequency (10^4Hz). No difference was found between the elastic and inelastic behavior of the unirradiated sample and that of the samples irradiated with doses up to about 360 Mrad. In the case of samples submitted to higher doses (up to about 4000 Mrad) a small decrease of Young's modulus at room temperature was observed. A small shift of the glass transition point and of the corresponding damping maximum towards higher temperatures and an increase of the area below the damping factor-temperature curve in the region of high dissipation were also found. All these effects increased with increasing doses of radiation and were attributed to the partial destruction of crystallinity and to cross linking provoked by the irradiation. At low temperatures a relaxation phenomenon characterized by a damping maximum at about –110°C, whose height increased with increasing doses of radiation, was observed. It was attributed to the excitation of oscillatory motions of phenyl rings in the amorphous regions. Its increase with increasing doses is put into relation with the increase in the amorphous/crystalline ratio caused by the irradiation. In the low temperature range, marked differences were observed between the mechanical spectra of isotactic and atactic polystyrenes. (auth)

7169 RADIATION-INDUCED CHAIN OXIDATION IN AQUEOUS Sb(III)–Fe(II) SOLUTION. [PART] I. Matsuura, Niro; Kurimura, Yoshimi; Takizawa, Masao (Inst. of Physical and Chemical Research, Tokyo). Rika Gaku Kenkyusho Hokoku, 38: 328-33(1962). (In Japanese).

Gamma-induced oxidation of antimony(III)-iron(II) in 0.8N sulfuric and 0.8N hydrochloric acids was studied, especially the effect of oxygen on the yield. The samples were irradiated at dose rates of 2.29×10^4 and 6.8×10^4 r/hr for aerated and deaerated systems, respectively, at about 20°C. Only in aerated H_2SO_4 medium was the oxidation found to proceed by a chain reaction; for example, for initial concentrations of 4×10^{-4}M $Sb^{(III)}$ and 2×10^{-4}M $Fe^{(II)}$, two values of G, i.e., $G(-Sb^{(III)})$ of 43 and $G(Fe^{(III)})$ of 104, were obtained. For a given initial concentration of $Sb^{(III)}$ of 4×10^{-4}M, it was found that: (1) $G(-Sb^{(III)}) = 15 \times 10^4[Fe^{(II)}] + 14$ and $G(Fe^{(III)}) = 39 \times 10^4[Fe^{(II)}] = 2 \times 10^{-4}$M, and (2) $G(-Sb^{(III)}) = 2.0[Fe^{(II)}]^{-0.36}$ and $G(Fe^{(III)}) = 1.0[Fe^{(II)}]^{-0.55}$, where $[Fe^{(II)}] > 2 \times 10^{-4}$M. $G(-Sb^{(III)})$ and $G(Fe^{(III)})$ values in the system of aerated HCl were 2.0 and 6.0, and those in N_2-saturated H_2SO_4 were 0.24 and 0.5, respectively. The combined action of $Sb^{(III)}$ and $Fe^{(II)}$ species in dilute H_2SO_4 appears to be largely responsible for the chain oxidation observed. (BBB)

7170 ELASTOMERS FOR USE IN RADIATION FIELDS. PART X. EFFECT OF GAMMA RADIATION ON MISCELLANEOUS NITRILE ELASTOMERS. Harrington, Robert (General Electric Co., Richland, Wash.). Rubber Age, 97: No. 6, 88-96(Sept. 1965).

The effect of radiation exposure on different types of nitrile elastomeric compounds and how the various constituents affect the radiation resistance of the compounded materials are discussed. All materials were exposed to gamma radiation in air at 25°C and normal atmospheric pressure, and evaluated by recording changes in physical properties and appearance. (REIC)

7171 THE EFFECT OF γ-RAY RADIATION IN VACUO ON SEVERAL KINDS OF CONJUGATED COMPOUNDS CONTAINING NITROGEN. Kurahashi, Yumiko; Kurihara, Katsumi (Tokyo Kyoiku Univ.). Shinku Kagaku, 13: 2-4(Aug. 1965). (In Japanese).

Several kinds of conjugated nitrogen compounds, e.g., N,N′-di-(2-acetylvinyl)-m-phenylenediamine(I), N,N′-di-(2-acetylvinyl)-p-phenylenediamine(II), 1,4-diphenyl-3,5-diacetyl-1,4-dihydropyridine(III), and melanin(IV) were found to be stable to γ irradiation in vacuo (total dose 5×10^7 R, dose rate 1.5×10^5 R/hr), except that II showed change in its uv absorption spectrum, and the solubility of IV in dimethylformamide decreased during irradiation. (auth)

7172 EFFECT OF THE INTERACTION OF ACTIVATORS AND DURATION OF ROENTGENIZATION ON THE ABSORPTION SPECTRA OF NaCl–Cu, Pb–PHOSPHORS. Khlevnyuk, A. T. (Korolenko Poltava Pedagogical Inst., USSR). Ukr. Fiz. Zh., 10: 1007-14(Sept. 1965). (In Ukrainian).

The spectra of the activator and supplementary absorption of NaCl–Cu and Pb-phosphors were investigated. Repeated measurements of the supplementary absorption spectra of phosphors with preliminary roentgenization before each measurement (using a short exposure) showed that these spectra depend on the length of roentgenization. Such a dependence is explained by ionic processes in the crystals occurring during roentgenization. It is shown that these ionic processes differ from those going on at high temperatures. The fact that new absorption maxima arise in two-activators with a definite concentration ratio indicates a strong interaction of the activators. (auth)

7173 ESR STUDY OF THE STRUCTURAL CHANGES IN POLYETHYLENE CAUSED BY HIGH DOSE IRRADIATION. Grishina, A. D.; Bakh, N. A. (Inst. of Electrochemistry, Academy of Sciences, USSR). Vysokomol. Soedin., 7: 1698-1700(Oct. 1965). (In Russian).

Structural changes in polyethylene due to absorption of doses from 6×10^2 to 2.2×10^4 Mrad were investigated by ESR. It is shown that the ESR spectrum is due to linear polyenic structures if the dose is below 2×10^3 Mrad and to cyclic polyenic structures if the dose is above 6×10^3 Mrad. Polyconjugated cyclic structures were disseminated in the less structuralized material. (auth)

7174 ADHESION OF RADIATION-HARDENED POLYESTER RESINS TO HIGHLY ORIENTED ORGANIC FIBERS. Kurilenko, A. I.; Shiryaeva, G. V.; Karpov, V. L. (Karpov Inst. of Physics and Chemistry, USSR). Vysokomol. Soedin., 7: 1707-12(Oct. 1965). (In Russian).

The adhesion of radiation-hardened polyester resins to highly oriented viscose, lavsan, caprone, and polypropylene fibers was investigated. The nature of the dependence of the adhesion on the polymer species in radiation and in thermal hardening was qualitatively the same. A change in the radiation dose to 10 Mrad caused an increase in the strength of adhesion of the resin to fiber, while further increase to 60 Mrad caused practically no further change in the magnitude of the adhesion. (auth)

7175 STRUCTURATION IN RADIATION SULFOCHLORINATED POLYETHYLENE AND ITS SOLUTIONS. Khromenkov, L. G.; Dzhagatspanyan, R. V.; Sokolov, V. A.; Korolev, B. M.; Zetkin, V. I. Vysokomol. Soedin., 7: 1776-8(Oct. 1965). (In Russian).

The formation and genesis of the morphological forms of sulfochlorinated and chlorinated polyethylene initiated by ^{60}Co γ rays under fluid bed conditions were investigated. It is shown that an increase in the halogen content lowers the regularity of the polymer structure. Insufficient homogeneity of halogenation under the given conditions was noted, leading to retention of crystallinity at high halogen contents. For low-pressure polyethylene it was confirmed that supermolecular polymer formations arose directly in the polymerization process. In radioinduced sulfochlorination gradual breakdown of the crystalline structure took place. (auth)

7176 POLYMERIZATION OF SILICONE OIL ON THE ELECTRON IRRADIATED SURFACE OF A SOLID. Tsapuk, A. K.; Kolotyrkin, V. M. (Karpov Inst. of Physics and Chemistry, USSR). Vysokomol. Soedin., 7: 1802-6(Oct. 1965). (In Russian).

Thin polymer films were obtained on stainless steel and sodium chloride surfaces irradiated with electrons in an atmosphere of silicone oil. Relations were obtained between the rate of growth of the films and the irradiation time, electron energies, and oil vapor pressure. The dielectric properties of the films, resistivity, dielectric constant, dielectric loss tangent, and the dielectric strength, were evaluated. (auth)

7177 THE ROLE OF THE HO_2 RADICAL IN THE BLEACHING OF AQUEOUS DYE SOLUTIONS BY ^{60}Co γ RAYS. Rakintzis, Nikolaus; Papaconstantinou, Elias; Schulte-Frohlinde, Dietrich (Democritus Nuclear Research Center, Athens). Z. Physik, Chem. (Frankfurt), 44: 257-69(Mar. 1965). (In German).

The radiochemical bleaching of seven dyes (neutral red, safranine T, K-indigo tetrasulfonate, acridine orange, methylene blue, K-indigo trisulfonate, and K-indigo disulfonate) by a ^{60}Co source (650 rad/min) was studied kinetically. Experiments were run in the presence of 2,5-dichlorohydroquinone and in its absence. In its presence the bleaching occurred from the presence of HO_2 radicals. This was confirmed by comparison by the action of chemically produced HO_2 (by the reduction of H_2O_2 with Ce(IV). These radicals did not appreciably attack safranine T and neutral red, but methylene blue, acridine orange NO, and particularly the indigo dyes were decolorized by HO_2. The G value for the reaction was strongly dependent on the dye concentration. The cause of this dependence was the disproportionation of the HO_2 radical; the range of values was from 0.0 to 5.75. The pH also affected the G value for some compounds, particularly the indigo dyes. (BBB)

7178 PHOTOCHEMISTRY OF URANYL OXALATE [Thesis]. Seed, James Richard. Davis, Calif., Univ. of California, 1964. 98p.

The photochemistry of the uranyl oxalate-oxalic acid system commonly used as a photochemical actinometer was studied. It was concluded that there were three major paths of decomposition which could be best described by the following three stoichiometric equations:

(1) $H_2C_2O_4 \xrightarrow[UO_2^{++}]{h\nu} CO + CO_2 + H_2O$;

(2) $H_2C_2O_4 \xrightarrow[UO_2^{++}]{h\nu} CO + HCOOH$; and

(3) $UO_2^{++} + H_2C_2O_4 \xrightarrow{h\nu} UO_2 + 2\,CO_2 + 2H^+$.

The distribution of products was found to be independent of the light intensity, wave length, and stirring rate and only very slightly dependent on the temperature. The relative contribution of the respective paths of decomposition were found to be very sensitive to the acid strength of the solution and the total oxalate concentration. It was concluded that the contribution of the first two paths, which were the major two paths under normal actinometer conditions, was determined by the concentration of two distinct photosensitive clusters. The complex species believed responsible for the observed stoichiometry of Path 1 was $(HC_2O_4UO_2C_2O_4)^-$ and the species believed to be responsible for the stoichiometry of Path 2 was $(UO_2C_2O_4)$. Mechanisms to account for the products of all three paths of oxalate decomposition were presented. The effects of various parameters on a function to relate the amount of oxalate decomposed and the production of easily analyzed gaseous products were discussed with reference to using the uranyl oxalate system as a microphotochemical actinometer. It was concluded that the total gaseous products per oxalate decomposed, $(CO + CO_2)/(C_2O_4^{=})$, was the most advantageous relationship to use. Some preliminary investigations of the photochemistry of uranyl sensitized formic acid were also discussed and a mechanism for the major decomposition path was presented. The mechanism postulated for the uranyl sensitized formic acid decomposition is analogous to that proposed for the third path of decomposition of oxalic acid. (A.G.W.)

7179 ELECTRON SPIN RESONANCE STUDIES OF FREE RADICALS IN IRRADIATED POLYETHYLENE [Thesis]. Wilson, Larry Kittrell. Nashville, Vanderbilt Univ., 1965. 146p.

The results of studies of radiation-induced free radicals in the chain polymer polyethylene by electron spin resonance (ESR) techniques are described. The design and operation of X-band ESR spectrometer, which utilizes both homodyne and superheterodyne detection, is also presented. Marlex 6050 cast film polyethylene was irradiated at room temperature with ultraviolet light at 253.7 mμ, 20-kv x-rays, and 0.5-Mev gamma rays. The samples were irradiated in vacuo and in nitrogen. The samples irradiated with ultraviolet light gave no detectable ESR spectra, which seemed to indicate that no long-lived radicals are produced by ultraviolet photolysis. X- and gamma-irradiated samples gave a relatively stable septet spectra with approximately 15 gauss splitting except for the case of the sample x irradiated in vacuo. This particular case gave an anomalous temporal variation. The samples irradiated in nitrogen had a lower spin concentration and the ESR spectra decayed faster than the spectra for the other samples. The failure to observe an ESR spectrum in any of the ultraviolet-irradiated samples perhaps indicates that the radicals produced during ultraviolet photolysis are very short-lived and may be altogether different from those produced by ionizing radiations. At the same time, it may be that the observed radicals produced by ionizing radiations have nothing to do with scission and cross-linking. The production of the septet spectra by ionizing radiations is not readily explainable by any currently accepted mechanism. The septet spectra observed did not possess the correct ratio of intensities for a pure septet, indicating a possible superposition of ESR lines. (Dissertation Abstr.)

7180 POLYMER PRODUCTION FROM AQUEOUS SOLUTIONS OF D-GLUCOSE BY HIGH ENERGY RADIATION [Thesis]. Snell, John Bradford. Inst. of Paper Chemistry, Appleton, Wis., 1964. 107p.

In this study, 1.0% aqueous glucose solutions were passed repeatedly under the beam of an electron accelerator until the desired dose was achieved. The dose rate was varied by changing the frequency of the passes under the electron beam. The yield of polymer, measured as either nondialyzable material or ethanol precipitate, increased with both the dose and the dose rate. These results would be expected from the previously proposed mechanism that involves hydrogen abstraction from the sugar molecules followed by coupling of the

resulting sugar free radicals. The weight average molecular weights of the whole polymers isolated by ethanol precipitation were measured in water solution by light scattering. The molecular weights ranged from 9,800 to 5,000,000. The polymers exhibited intrinsic viscosities in the range of 0.02 to 0.26 dl./g in water at 30.000 ± .005°C, and are therefore thought to be very highly branched. One polymer was fractionated on a column of Sephadex, and the chemical composition of the fractions compared. Fractionation by molecular weight was demonstrated. The carboxyl content of the fractions, measured by titration with dilute sodium hydroxide, increased regularly with molecular weight. Infrared absorption spectra of the fractions showed a single carbonyl peak at 1760 cm^{-1} for the low molecular weight material and peaks at 1760 and 1720 cm^{-1} for the higher molecular weight material. The peak at 1760 cm^{-1} was attributed to lactone formation and that at 1720 cm^{-1} to carboxyl formation. Elemental analyses of the fractions showed that the composition of the low molecular weight material was similar to that of gluconolactone. Despite the increase in carboxyl content, the hydrogen and oxygen content decreased with molecular weight. (Dissertation Abstr.)

7181 INTRODUCTION A L'EMPLOI DE RAYONNEMENTS EN CHIMIE PHYSIQUE. TOME 1. CHEMINEMENT DES PARTICULES CHARGEES. (Introduction to the Use of Radiation in Physical Chemistry. Volume 1. Penetration of Charged Particles). Cauchois, Yvette; Heno, Yvonne. Monographies de Chimie Physique. Paris, Gauthier - Villars, 1964. 273p.

The use of radiation in physical chemistry is discussed with regard to the passage of charged particles in matter. Electrons and light positive particles are considered in the low energy range. Different types of collisions were examined and theoretical expressions for the energy losses during these collisions were derived. The energy loss from bremsstrahlung is considered. Expressions for the total energy loss are derived and discussed in detail. (J.S.R.)

7182 ELEMENTARNYE PROTSESSY KHIMII VYSOKIKH ENERGII. TRUDY SIMPOZIUMA PO ELEMENTARNYM PROTSESSAM KHIMII VYSOKIKH ENERGII (MOSKVA, 18–22 MARTA 1963 g.). (Elementary Processes in High-Energy Chemistry. Reports of the Symposium on Elementary Processes in High-Energy Chemistry, Moscow, Mar. 18–22, 1963). Tal'roze, V. L. (ed.). Moscow, Izdatel'stvo Nauka, 1965. 319p. (CONF-630302).

Summaries of sixty six reports are included on elementary processes in high-energy chemistry. Elementary processes in gases and in condensed gas phases are discussed as well as chemical reactions as possible sources of induced radiation. (R.V.J.)

7183 METHOD FOR PRODUCING A GRAFT COPOLYMER. Amemiya, Ayao; Miyaguchi, Minoru (to Dai Nippon Spinning Co. Ltd.). Japanese Patent 1964-18980. Sept. 4, 1964. Filed Dec. 8, 1961.

It was found that, when a certain kind of metal salt is present in the graft copolymerization of a monomer on to a natural or synthetic high polymer, the time of irradiation is greatly reduced. Thus, by the method proposed, a vinyl monomer is graft-copolymerized on to a natural or synthetic high polymer or its derivative by the ionizing radiation in the presence of more than 10^{-7} mole per gram of copolymer of a metal salt, which dissociates into tin, titanium, nickel, cobalt, chromium or manganese. (NSA of Japan)

Radiochemistry

See also Separation Processes and Procedures

Refer also to abstracts 7182 and 7421.

7184 (AEET–216) ISOTOPIC EXCHANGE IN THE SOLID STATE AND THERMAL ANNEALING OF RECOIL DAMAGE IN COBALT COMPLEXES. Nath, Amar; Khorana, S.; Mathur, P. K.; Sarup, S. (Atomic Energy Establishment, Trombay (India). Chemistry Div.). June 1965. 5p. Dep. mn.

Investigations on several cobalt complexes showed that the so-called open-type complexes exhibit little exchange while others exhibit a large amount of exchange. The isotopic exchange is presumably preceded by capture of free electrons by Co^{2+} species and therefore the exchange is determined by the rate of release of electrons from traps or valence bond. On the basis of this mechanism, the relation between isotopic exchange in the solid state and thermal annealing of recoil damage becomes apparent. (P.C.H.)

7185 (AEET–224) FACILITY FOR STANDARDIZATION OF RADIONUCLIDES. Gupta, U. C.; Srivastava, P. K.; Misra, S. C.; Sidhu, N. P. S.; Dhingra, K. C.; Khera, G. D.; Sahoo, H. K.; Rao, P. S. (Atomic Energy Establishment, Trombay (India). Electronics Div.). 1965. 38p. Dep. mn.

Techniques and instruments used for the standardization of radionuclides in the Electronics Division are described. The standardization procedures are briefly described and the accuracy of the results obtained using several methods are tabulated. Standardization of radioactive sources includes determination of the total disintegration rate and radiochemical purity of the sample under study. (P.C.H.)

7186 (NAS-NS-3002(Rev.)) RADIOCHEMISTRY OF ARSENIC. Beard, Harold C. (Florida State Univ., Tallahassee); Cuningham, J. G. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1960. Revised 1965. 43p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Nuclear Science Series of National Academy of Sciences–National Research Council, Washington, D. C. Committee on Nuclear Science.

Information is included on: physical properties of arsenic; isotopes; decay schemes; γ-spectra; chemistry of arsenic; dissolution of arsenic samples; counting techniques pertinent to arsenic isotopes; and radiochemical procedures for arsenic. References are given to reviews on the inorganic, analytical, and radiochemistry of arsenic. (P.C.H.)

7187 MEDICAL INSTRUMENT UTILIZING THE RADIOACTIVITY CONTAINED IN HOT-SPRING DEPOSIT. Kawai, Saku (to Seki Co., Ltd.). Japanese Patent 1964-20715. Sept. 30, 1964. Filed Aug. 5, 1959.

A medical instrument using the radioactivity contained in hot-springs is proposed. The hot-spring water is led through a conduit, where a deposit is obtained. This deposit is dried and burned to remove inflammable impurities such as sulfur, etc. leaving the radioactivity. The particles obtained are fixed with a fixing substance, so that the product will have a radioactivity of 200–2000 counts per min. (NSA of Japan)

Separation Processes and Procedures

See also Analytical Procedures
ISOTOPE TECHNOLOGY — Separation and Production

Refer also to abstract 8172.

7188 (EUR–2088.f) REACTOR FUEL REPROCESSING BY VOLATILIZATION. Schmets, J.; Broothaerts, J.; Camozzo, G. (and others) (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). European Atomic Energy Community). 1965. 145p. Dep. mn.

Various fuel reprocessing schemes using halogenation were studied. The main investigations were carried out on the UO_2–PuO_2 cycle. Both the fundamental and technological aspects of these reactions were studied. The uranosic-oxide hydrofluorination variant was found to be better suited for the practical realization of the process. Some fundamental studies and applied research have been carried

out on simplified reprocessing cycles such as UC → UF_4 → UF_6, UO_2 (or UC) → UO_2 → UF_6, UO_2 → UCl_6, and UO_2 → UCl_n → UF_{4-5} → UF_6. The first of these cycles lends itself better to a technological development, whereas the second one seems rather hard to be achieved, because of its limited reaction conditions and the properties of the powders formed. The chlorination cycle meets with difficulties to conciliate the uranium yield, the decontamination factor, and the technology requirements. The last process was taken into consideration from a chemical point of view. (auth)

7189 (EURAEC–1339) REPROCESSING OF IRRADIATED FUELS. Quarterly Report No. 17, April 1–June 1964. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Contract 004-64-4 RCIP (RD). 29p. (EUR–2315; R–2326). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Work Performed Under United States–Euratom Joint Research and Development Program.

Separation of U and Pu by ClF_3 is difficult above 20% Pu enrichment. Decladding of vibrated-swaged units by vibration and heating is feasible. Research on the conditions for the volatilization of UF_6 by ClF_3 was principally concerned with the progress of the reaction at 200°C and the overall reaction rate at various temperatures. At 200°C a fast initial reaction is observed, accompanied by heat evolution. Study of the effect of temperature on the reaction rate showed the existence of minima at 75 and 150°C. U_3O_8 hydrofluorination in the presence of fissium requires more time than for pure U_3O_8. At 500°C the presence of fissium enables good control of hydrofluorination. U volatilization by F_2 does not seem to be affected by the presence of fissium. The distribution base-plate intended for the alpha 1 cell and for the biological shielding of the hot semipilot was put in position. The framework was assembled under white heat and was put through acceptance tests. Assembly of the gas storage tank and distribution system has begun. Eighteen simulator rods intended for the hot semipilot were irradiated in the BR1 reactor. (J.R.D.)

7190 (EURAEC–1396) REPROCESSING OF IRRADIATED FUELS. Special Report No. 5. Mission Report No. 3, November–December 1964. Heremans, R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Contract 004-64-4 RCIB(RD). 19p. (EUR–2355; R–2336). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The present state of the technology of reprocessing spent reactor ceramic fuels by volatilization of fluorides at the Centre d'Etude de l'Energie Nucleaire in Belgium is compared with that at ANL, BNL, and ORNL. (W.L.G.)

7191 (IDO–14643) DEVELOPMENT OF A CONTINUOUS ELECTROLYTIC PROCESS FOR RECOVERY OF URANIUM FROM HIGH-ENRICHED STAINLESS STEEL AND NICHROME FUELS. Kerr, W. B.; Lakey, L. T.; Denney, R. G. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Oct. 1965. Contract AT(10-1)-205. 65p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A horizontal, trough-shaped, electrolytic dissolver employing the solution-contact principle was successfully developed on a pilot-plant scale for dissolution in nitric acid of highly enriched stainless steel and Nichrome cermet fuel elements. Simulated and actual fuels were dissolved at rates acceptable for a plant-scale installation. Uranium losses in the small amount of undissolved material released as a result of intergranular corrosion of the fuel during dissolution were determined to be insignificant. The effects of operating variables upon the dissolution rate were determined, and methods were developed for controlling the dissolver system to produce a desired product composition. Gelatin added to the circulating product solution was found to prevent the formation of siliceous sludge deposits on internal surfaces of the dissolver. Sodium hydroxide proved to be an effective and non-corrosive cleaning agent for the system. Analyses indicated that explosion hazards due to hydrogen formation were unlikely and easily prevented. The conceptual design of a plant-scale dissolution system is described. (auth)

7192 (K–1649) ORGDP FUEL REPROCESSING STUDIES SUMMARY PROGRESS REPORT, FISCAL YEAR 1964 THROUGH FISCAL YEAR 1965. Smiley, S. H.; Brater, D. C.; Pashley, J. H. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 29, 1965. Contract W-7405-eng-26. 104p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Results of studies concerning processes for recovery of Pu and U from spent fuels are presented. Process flowsheet economic comparisons are included. Problem areas are indicated and optimum routes for successful commercial processes are suggested. Efforts devoted to components development are reported in which scale-up and testing of process equipment are programmed. (J.R.D.)

7193 (RL-SEP–550) LABORATORY TESTS OF FILTRATION CHARACTERISTICS. Curtis, M. H. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). June 9, 1965. Contract AT(45-1)-1350. 11p. ORAU.

A total of 10 plutonium(IV) oxalate precipitations and filtrations were made on a small batch scale (10 g Pu). The results are presented, along with discussion, to show the potential of the technique. (P.C.H.)

7194 SOLVENT EXTRACTION STUDY OF TRIVALENT ACTINIDE AND LANTHANIDE COMPLEXES IN AQUEOUS SOLUTIONS. I. CHLORIDE COMPLEXES OF La(III), Eu(III), Lu(III), AND Am(III) in 4 M $Na(ClO_4)$. Sekine, Tatsuya (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 19: 1435-44(1965).

The complex formation of La(III), Eu(III), Lu(III), and Am(III) with chloride ions was studied in 4M $Na(ClO_4)$ at 25°C by a distribution method. The metal distribution ratio D between an organic phase containing a chelating acid and aqueous phases of various chloride concentrations was measured and the stability constants were calculated from the decrease of the distribution ratio caused by the formation of chloride complexes. The constants were finally refined by a generalized least squares method using the LETAGROP VRID computer program. (auth)

7195 SOLVENT EXTRACTION STUDY OF TRIVALENT ACTINIDE AND LANTHANIDE COMPLEXES IN AQUEOUS SOLUTIONS. II. SULFATE COMPLEXES OF La(III), Eu(III), Lu(III), AND Am(III) IN 1 M $Na(ClO_4)$. Sekine, Tatsuya (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 19: 1469-75(1965).

The complex formation of La(III), Eu(III), Lu(III), and Am(III) with sulfate ion was studied in 1M $Na(ClO_4)$ at 25°C by a distribution method. The metal ions in aqueous solution were equilibrated with 2-thenoyltrifluoroacetone in chloroform, in chloroform containing tributylphosphate, or in carbon tetrachloride containing methylbutylketone, and the complex formation was determined from the decrease of the distribution ratio when various amounts of sulfate ion were introduced in the solution. The stability constants of the sulfate complexes were calculated by a generalized least squares method, using the LETAGROP VRID computer program. (auth)

7196 SOLVENT EXTRACTION STUDY OF TRIVALENT ACTINIDE AND LANTHANIDE COMPLEXES IN AQUEOUS SOLUTIONS. III. OXALATE COMPLEXES OF La(III), Eu(III), Lu(III), AND Am(III) IN 1 M $Na(ClO_4)$. Sekine, Tatsuya (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 19: 1476-82(1965).

The complex formation of La(III), Eu(III), Lu(III), and Am(III) with oxalate ions in 1M $Na(ClO_4)$ at 25°C was studied by a distribution method. The metal distribution between an organic phase containing 2-thenoyltrifluoroacetone (TTA) and tributylphosphate (TBP) or methylisobutylketone (hexone), and aqueous phases of various oxalate concentrations was measured, and the stability constants were calculated from the decrease of the distribution ratio caused by the formation of oxalate complexes after making a correction for the formation of $HC_2O_4^-$ (the dissociation of acid ox-

alate was determined as $pK_{32} = 3.54 \pm 0.01$ in 1 M $Na(ClO_4)$ at 25°C by separate experiments). The constants were refined by a generalized least squares method using the LETAGROP VRID computer program. The best-fit stability constants obtained are given. (auth)

7197 ION EXCHANGER SELECTIVE TO ZIRCONIUM AND HAFNIUM IONS. Lewandowski, Anzelm; Szczepaniak, Walenty (Univ., Poznan, Poland). Chem. Anal. (Warsaw), 10: 961-4(1965). (In Polish).

The preparation and properties of an ion exchanger, selective to zirconium and hafnium ions, is described. As a reacting component of the exchanger morin was used. In presence of 0.5N hydrochloric acid only the Zr and Hf cations are retained on the exchanger column, while others, including the tetravalent ones are passing through. Elution of zirconium and hafnium was carried out by using 4 or 6N hydrochloric acid. An enrichment of last effluent fractions in hafnium was observed. (auth)

7198 SEPARATION OF ^{137}Cs FROM URANIUM FISSION PRODUCTS BY MEANS OF ZINC FERROCYANIDE. Kourim, V.; Million, B. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Collect. Czech. Chem. Commun., 30: 2848-50(Aug. 1965). (In German).

The chromatographic separation of Cs from Sr, Ce, Ru, Zr, and Nb by means of ion exchange on zinc ferrocyanide was investigated. The radiochemical purity of the separated Cs was satisfactory (concentration of radioactive impurities not more than 5%). (tr-auth)

7199 PLUTONIUM, URANIUM, AND ZIRCONIUM EXTRACTION FROM SOLUTIONS CONTAINING COMPLEX FORMING SUBSTANCES. I. INFLUENCE OF SOME COMPLEX-FORMING SUBSTANCES ON THE EXTRACTION OF PLUTONIUM(IV) BY MEANS OF NITRIC ACID SOLUTIONS OF TRIBUTYLPHOSPHATE. Beran, M.; Zdrazil, K.; Havelka, S. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Collect. Czech. Chem. Commun., 30: 2850-4(Aug. 1965). (In German).

The effect of some complex-forming substances on the extraction of Pu(IV) from HNO_3 solutions with 30% solutions of TBP in petroleum fractions was investigated. The results were considered from the viewpoint of the applicability to the improvement of the separation factor in the Purex process. Apart from oxalic acid, already used commercially, the most promising results were obtained for chromotropic acid and arsenazo I. (tr-auth)

7200 NEW MODE OF REGENERATION OF ION EXCHANGE RESINS IN METHYLIC AND ETHYLIC MEDIA. Beiere, Georges; Felici, Noel (Laboratoire d'Electrostatique et de Physique du Metal, Grenoble, France). Compt. Rend., 261: 3385-8(Oct. 27, 1965). (In French).

The efficiency of ion exchange resins (usually regenerated in aqueous solutions) is found to increase, during the deionization of autoprotolytic liquids, by a functional regeneration made using acidobasic Brønsted solutions corresponding to the liquid. The experimental study was made in the case of methanol and ethanol. (tr-auth)

7201 LIQUID–LIQUID EXTRACTION IN THE SODIUM OXIDE–BORON OXIDE–SODIUM CHLORIDE SYSTEM. Rowell, Monte H. (Naval Radiological Defense Lab., San Francisco). Inorg. Chem., 4: 1802-6(Dec. 1965).

Liquid–liquid extraction was accomplished in molten salt media by the use of molten borates as the extracting phase. Radioactive tracers were used to measure the distribution of micro quantities of Cs, Rb, Ba, Sr, Nd, Eu, and Ag between the two conjugate liquid phases throughout the immiscibility region in the system $Na_2O-B_2O_3-NaCl$ at 830°C. Borate/salt distribution coefficients were extremely sensitive both to phase compositions and to the nature of the solute ion. Cations of the alkali metal, alkaline earth, and rare earth groups showed good separation factors and an order of selectivity dependent on field strength. Selectivity appeared to be based largely on cation-exchange properties of the borate phase. The distribution behavior of silver was compatible with that to be expected of a highly charged chloro anion. (auth)

7202 SEPARATION OF RARE EARTHS BY FLUID ION EXCHANGE. III. THIN-LAYER CHROMATOGRAPHIC SEPARATION OF RARE EARTHS. Holzapfel, H.; Lan, Le Viet; Werner, G. (Karl-Marx Univ., Leipzig). J. Chmomatog., 20: 580-4(Dec. 1965). (In German).

Silica gel treated with di-(2-ethylhexyl)-phosphoric acid was used for separation of the rare earths by thin-layer chromatography. It was possible to separate all pairs of the elements La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Y, and Yb (except the pairs Pr–Nd and Er–Y) by elution with HCl or HNO_3 of appropriate concentration. Elution with HNO_3 gave a better separation. (auth)

7203 CARRIER-FREE SEPARATION OF THE INDIVIDUAL RARE EARTH RADIONUCLIDES FROM FISSION PRODUCT MIXTURES. Wish, L.; Foti, S. C. (Naval Radiological Defense Lab., San Francisco). J. Chromatog., 20: 585-93(Dec. 1965).

A procedure based on solvent extraction with diethylhexylphosphoric acid was tested for the quantitative carrier-free separation of yttrium and the rare earth group elements from other fission products. This procedure is simpler and more rapid than the previously used cation exchange resin separations of rare earths from alkali metals and alkaline earths. Subsequent quantitative carrier-free isolation of individual rare earth fission products was accomplished by their elution from cation exchange resin with alpha-hydroxyisobutyric acid at room temperature. (auth)

7204 ON THE STUDY OF BISMUTH PHOSPHATE AS A CARRIER FOR TETRAVALENT ACTINIDES. Purkayastha, B. C.; Sen, Shyamoli (Saha Inst. of Nuclear Physics, Calcutta). J. Indian Chem. Soc., 42: 517-22(Aug. 1965).

In the presence of an excess of bismuth, an unstable form of bismuth phosphate takes up UX_1 through mixed crystal formation even in presence of finite quantities of thorium. That the host lattice is unstable was demonstrated by determining λ values at intervals of time after the addition of reactants. Even after fifteen min, the constancy of the heterogeneous distribution factor (λ) was found to disappear; it did not obey the homogeneous distribution law on prolonged equilibration. ^{95}Zr and ^{95}Nb were taken up through adsorption by the host lattice, which did not take up any appreciable amount of rare earth or yttrium activities. A laboratory procedure of separating tetravalent actinides from the tervalent ones was developed. Both stable and unstable forms of bismuth phosphate were found to take up zirconium through adsorption. Only the tetravalent actinides are taken up by an unstable form of bismuth phosphate through mixed crystal formation. (auth)

7205 ON THE STUDY OF A SIMPLE METHOD OF SEPARATION OF CARRIER-FREE RaE FROM RaD. Purkayastha, B. C.; Rao, A. Shyam Sundar (Saha Inst. of Nuclear Physics, Calcutta). J. Indian Chem. Soc., 42: 555-9(Aug. 1965).

A procedure for separating carrier-free ^{210}Bi from ^{210}Pb was developed. The principle involves addition of ammonium acetate to the carrier-free solution of ^{210}Pb in equilibrium with ^{210}Bi, thereby raising the pH above 6.6. The solution is passed through a column of glass powder where most of the daughter is adsorbed and nearly all of ^{210}Pb passes away on washing with water. The ^{210}Bi adsorbed on glass powder is then eluted by hot concentrated nitric acid. The daughter activity is of very high radiochemical purity. In this process 3% of the daughter activity is retained by glass surface. On introducing a correction factor of 3%, a complete quantitative separation can be achieved. The method is also successful in the presence of excess of lead. Too much ammonium acetate has a bad effect on the extent of adsorption of ^{210}Bi on glass powder. (auth)

7206 A STUDY OF THE NITRATE AND THE CHLORIDE COMPLEXES OF PLUTONIUM(VI) BY SOLVENT EXTRACTION TECHNIQUE USING TTA AS THE CHELATING AGENT. Ghosh Mazumdar, A. S.; Sivaramakrishnan, C. K. (Atomic Energy Establishment, Trombay, India). J. Inorg. Nucl. Chem., 27: 2423-7(Nov. 1965).

Solvent extraction of hexavalent plutonium from nitrate–

perchlorate and from chloride–perchlorate mixtures into benzene containing thenoyl trifluoroacetone (TTA) was studied in order to investigate the formation of the nitrate and chloride complexes of plutonium(VI). It is shown that only neutral chelates of PuO_2^{2+} ions get extracted into the organic phase from perchlorate, nitrate, or from chloride media. The equilibrium constants of $PuO_2(NO_3)^+$ and PuO_2Cl^+ were calculated to be 0.93 and 1.05, respectively, at an ionic strength of 4.1. By using micro concentrations of plutonium(VI), it was observed that the metal ions were slowly reduced to the more extractable plutonium(IV) state during the process of extraction and that the use of permanganate or dichromate could not prevent this reduction completely. Further investigations showed that this reduction could be practically eliminated if the solution phases were protected from light during the equilibration process. That plutonium(VI) ions can take part in photochemical reactions was qualitatively confirmed by irradiating a mixture of plutonium(VI) and oxalic acid in perchloric acid solution with ultraviolet rays and observing the reduction. (auth)

7207 SOME STUDIES OF THE SOLVENT EXTRACTION OF ^{7}Be. Morris, D. F. C.; Jones, M. W. (Brunel Univ., London). J. Inorg. Nucl. Chem., 27: 2454-8(Nov. 1965).

Measurements were made of the distribution of ^{7}Be between dinonyl naphthalene suffonic acid (HD) in n-heptane and aqueous solutions of some mineral acids. Extraction of ^{7}Be from aqueous chloride solutions by trioctylamine and tributyl phosphate was also studied. The distribution of ^{7}Be was found to be a function of the inverse second power of the concentration of hydrogen ion in the equilibrium aqueous phase. The beryllium partition varied with the first power of the concentration of HD in the organic phase. (F.J.H.)

7208 EQUILIBRIA OF THE SYSTEMS, $PrCl_3$–HCl, $NdCl_3$–HCl, AND $PrCl_3$–$NdCl_3$–HCl WITH DI-(2-ETHYL HEXYL) PHOSPHORIC ACID IN AMSCO 125-82. Goto, Totaro (Government Chemical Industrial Research Inst., Tokyo); Smutz, Morton. J. Nucl. Sci. Technol. (Tokyo), 2: 410-15(Oct. 1965). (IS-1132).

Extractions of Pr and Nd by 1.0M di-(2-ethyl hexyl) phosphoric acid (D2EHPA) in Amsco 125-82 were carried out from $PrCl_3$–HCl and $NdCl_3$–HCl aqueous solutions with initial concentrations from 0.0 to 1.0M HCl and 0.10 to 1.0M $PrCl_3$ or $NdCl_3$. Distribution coefficients of Pr and Nd were obtained as a function of initial concentration of HCl with initial concentrations of Pr and Nd as parameters. Concentrations of Pr and Nd in both organic and aqueous phases for the systems 1.00M D2EHPA–$PrCl_3$–HCl and 1.00M D2EHPA–$NdCl_3$–HCl were also obtained using HCl concentrations in the aqueous phase at equilibrium as the parameter. Plots of these data were demonstrated to be useful for estimating final concentrations of Pr and Nd in the organic phase for the extractions of $PrCl_3$–HCl, $NdCl_3$–HCl and $PrCl_3$–$NdCl_3$–HCl solutions when the composition of the aqueous phase in equilibrium was known. (auth)

7209 COUNTER-CURRENT EXTRACTION IN A LABORATORY MIXER-SETTLER. III. THE DISTRIBUTION OF URANYL NITRATE AND NITRIC ACID IN THE EXTRACTION APPARATUS BY TRIBUTYLPHOSPHATE IN THE PUREX PROCESS. Sraier, Vratislav (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 11: 336-41(Sept. 1965). (In Czech.).

Uranyl nitrate and nitric acid concentrations in individual stages of the mixer-settler and in final solutions were determined for the parts 1BS, 1BX, 1C, 2A, 2B, 2D, and 2E of the Purex process in inactive scale. The composition of final solutions after the extraction is in good agreement with data from the literature. (auth)

7210 THE CHLORINATION OF NINGYOTOGE URANIUM ORE. Ino, Shiro; Kodama, Kenjiro (Government Chemical Industrial Research Inst., Tokyo). Kogyo Kagaku Zasshi, 68: 626-8(Apr. 1965). (In Japanese).

A method for extraction of uranium from the Ningyotoge ore deposits, which contain 0.065 to 0.24% U_3O_8, was developed on the basis of chlorination and vaporization procedures. The ore was first pulverized to pass a 150-mesh screen, pelleted (3 to 7 mm dia) with water, and chlorinated on a fixed bed by a mixture of Cl_2, CO, and CO_2. The factors having main effect on the vaporization of uranium as the chloride were the dehydration condition of the ore, temperature and time of chlorination, and composition and velocity of the chlorinating gas. Optimum dehydration of the ore was attained when it was heated to the chlorination temperature within 2 hr in the flowing CO_2 atmosphere. Good results were obtained by chlorination for 2 hr at 900 to 950°C with a mixture of Cl_2, CO, and CO_2 in a volume ratio of 1:1:6. After chlorination of the ore, the proportion of uranium vaporized from it was about 80%. Most of the Cl_2 was consumed in reactions with the silicates, feldspar, and clay present in the ore. (BBB)

7211 SOLVENT EXTRACTION OF CHELATE COMPOUNDS IN THE PRESENCE OF SALTS. COMMUNICATION 3. COBALT(II) AND URANIUM(VI) ACETYLACETONATES. Bagreev, V. V.; Zolotov, Yu. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim., 20: 867-9(1965). (In Russian).

The solvent extraction of cobalt(II) acetylacetonate with isopropyl alcohol in the presence of large amounts of neutral salts, $NaClO_4$, NaCl, $NaNO_3$, Na_2SO_4, and $Ca(NO_3)_2$, was studied. It is shown that the extraction percent increases in the presence of the above salts. The extraction of uranyl acetylacetonate with chloroform in the presence of NaCl, Na_2SO_4, and KCl was studied; all these salts improved the extraction. (auth)

7212 A METHOD OF EXTRACTING AND PURIFYING URANIUM WITH HIGHLY BASIC ANION-EXCHANGE SUBSTANCE. Shimizu, Hiroshi; Nozaki, Seiji (to Japan Organo Co.). Japanese Patent 1964-20640. Sept. 21, 1964. Filed Feb. 7, 1958.

By the method proposed, high-purity uranium is obtained easily at low cost. It consists of the following steps: (1) an impurity-containing uranium compound is converted into the anionic form by adding nitric acid. (2) the uranium is adsorbed on the highly basic anion-exchange substance, and (3) it is eluted from the exchanger substance after converting it into the cationic form by treating with water. (NSA of Japan)

7213 A METHOD FOR CONCENTRATING URANIUM. Imoto, Riichiro; Takagi, Toshiharu (to Toyo Soda Mfg. Co., Ltd.). Japanese Patent 1964-20641. Sept. 21, 1964. Filed Oct. 6, 1958.

Uranium is extracted selectively from its dilute solution and concentrated, using a chelate-type cation exchange resin in which the exchangeable hydrogen is replaced by an element of group 2A or 2B of the periodic table. A polyamine anion-exchange resin such as polyethylene polyamine is treated with acetic acid to obtain the cation-exchange resin. (NSA of Japan)

7214 DISSOLUTION OF NUCLEAR ALUMINUM-BASE FUEL. Schulz, Wallace W. (to U. S. Atomic Energy Commission). U. S. Patent 3,222,125. Dec. 7, 1965.

A process was developed for dissolving nuclear aluminum-base fuel. The fuel was immersed in boiling nitric acid at 0.8 to 1.2M containing mercuric ion catalyst in a concentration of between 0.003 and 0.015M until the fuel assumed a grey color. Concentrated nitric acid at boiling temperature was added in a quantity to obtain a concentration of between 4 and 6M whereupon the fuel was dissolved. (AEC)

7215 DISSOLUTION OF ZIRCONIUM IN TITANIUM EQUIPMENT. Clark, W. E.; Gens, T. A. (to U. S. Atomic Energy Commission). U. S. Patent 3,222,289. Dec. 7, 1965.

A method of dissolving zirconium salts in a titanium container system is described. The zirconium is reacted in the system with a zirconium dissolvent consisting essentially of a 2 to 6 molar aqueous solution of nitric acid containing total fluoride not exceeding 3M and a titanium corrosion-inhibiting concentration of soluble boron salts in the range from 0.2 to 0.4M as well as hexavalent chromium to the extent of at least 0.05M. (AEC)

ENGINEERING

General

Refer also to abstracts 7282 and 7634.

7216 (TID-4100(Suppl.30)) SUPPLEMENT INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Duthie, Richard E. C. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Nov. 1965. 58p. Dep.; DTI Extension Free.

Thirty-one CAPE packages are included under: computers; engineering equipment; hot laboratory equipment; hot laboratory structures; instruments; nuclear radiation instruments; nuclear reactors and reactor facilities; plant design and processing (chemical); and shielded containers. (P.C.H.)

7217 THE PRESENT STATUS OF INTERCHANGE OF THE NUCLEAR ENGINEERING IN JAPAN. Kawashima, Yoshiro (Atomic Energy Bureau, Japan). Genshiryoku Hatsuden, 7: 43-8(June 1963). (In Japanese).

Several kinds of problems in the development of the nuclear engineering and industry in Japan are discussed. The interchange of the nuclear engineering is treated in a broad sense and is summarized in each item of the atomic agreement in information exchange, collaboration, international conference, technical induction, dispatch and accession of investigation commission, trainees and experts, technical publications and abstracts, and patents. Then consideration is given to going way in the future. Concluding remarks are following two points: the acceleration of the interchange of progressing technique, and technical collaborations of the developing countries. (NSA of Japan)

7218 STRESSES AND DISPLACEMENTS IN PERFORATED PLATES. Goldberg, J. E. (Purdue Univ., Lafayette, Ind.); Jabbour, K. N. Nucl. Struct. Eng., 2: 360-81(Oct. 1965).

Results are presented of an analytical investigation of stresses and displacements in perforated plates, these results being of interest in such applications as tube sheets and grid plates in boilers, heat exchangers, and nuclear power reactors. The results are felt to be more comprehensive and detailed than those which can be obtained through the use of ligament theory. The plates are assumed to be uniform in thickness and of infinite extent in both directions and to have an infinite number of circular holes uniformly distributed in a regular triangular array. The investigation considers the plane stress problem within the usual assumptions of classical elasticity theory. Some remarks on the applicability of these results to the approximate solution of normal bending problems are included. Corresponding results for the normal bending problems of perforated plates are not given at the present time. However, in the absence of these solutions and pending their acquisition, the results for the plane stress problems might be used to deduce approximate results for the related pure bending and pure twisting problems. (auth)

7219 MATERIAL PROPERTIES FOR ORTHOGONAL ELASTICALLY REINFORCED MAXWELL BODIES WITH SMALL REINFORCEMENT ELEMENTS (FOR EXAMPLE STEEL CONCRETE). PART I. Hilliges, Dieter (Technical Univ., Berlin). Nucl. Struct. Eng., 2: 389-418(Oct. 1965). (In German).

Three-dimensional stress-strain relations for elastically reinforced viscoelastic bodies (of the type of reinforced concrete without cracks) are given, which are applicable to problems of continuous media. The compound body consists of a viscoelastic component obeying Maxwell's law, the volume of which is prevailing, and an elastic reinforcement component for which Hooke's law shall be valid. The reinforcement is supposed to consist of so many single bars that each element of the body contains one bar in each direction of the orthogonal reinforcement. The equations of displacement under the action of surface and body forces and temperature effects are given and their solution by disturbance calculation is outlined. The application of the method is explained by an example: a hollow sphere with circumferential and meridional reinforcement under the action of external pressure is analyzed for the case of Poisson's ratio equal to zero. (L.B.S.)

7220 IMPROVEMENT OF THE PURIFICATION OF ARGON AND HELIUM. Schaub, B.; Nolin, J. P. (CEN, Grenoble, France). Vide, 20: 281-8(July-Aug. 1965). (In French).

General methods of purification by chemical reactions, using metal getters and catalyzers, and by physical reactions, using selective adsorption of gases, are outlined. The efficiencies of various methods for removing oxygen, nitrogen, carbon monoxide, methane, and water impurities from helium and argon were determined as functions of temperature and time. The methods studied involved selective adsorption by MnO-CuO mixtures, Mg and Ca vapors, liquid Li, and molecular sieves. A method for analyzing the impurities in He at very low concentrations using gas-phase chromatography is described, and some results are presented. (M.J.T.)

Applications of Nuclear Explosions

7221 (UCRL-12131) GAS FLOW AND HEAT TRANSFER IN POROUS MEDIA. Rodean, Howard C. (Lawrence Radiation Lab., Univ. of California, Livermore). Oct. 26, 1964. Contract W-7405-eng-48. 30p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The equations for nonsteady gas flow and heat transfer in porous media are derived. The analysis is oriented toward problems associated with the use of underground nuclear explosions; hence equations are given for two symmetrical coordinate systems: cylindrical and spherical. The spherical-coordinate equations are appropriate for nuclear-explosion cavity pressure and venting problems. The cylindrical-coordinate equations are applicable to natural gas well performance and the inverse problem of recharging an underground reservoir with natural gas, two possible applications of nuclear explosives. Since a nuclear explosion deposits heat in the rock surrounding the shot point, heat transfer must be considered as part of the gas flow process. Difference equations, together with initial, boundary, and stability conditions, are presented for use in computer codes to obtain numerical solutions. The assumptions inherent in the Darcy equation of fluid motion are examined. (auth)

7222 (UCRL-14451) GROUND WATER RESOURCES USING NUCLEAR TECHNIQUES. Zodtner, Harlan H. (Lawrence Radiation Lab., Univ. of California, Livermore). Oct. 15, 1965. Contract W-7405-eng-48. 7p. (CONF-650954-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Ground Water Recharge, Development and Management Biennial Conference, Los Angeles.

The use of nuclear explosions for the recharge of ground water by crater formation is discussed. The SEDAN event is cited as an example of an experiment performed at the Nevada Test Site for studying crater phenomenology. The feasibility of the program and economics are evaluated. (P.C.H.)

Facilities and Equipment

7223 (TID-22477) A BIBLIOGRAPHY (WITH ABSTRACTS) ON GAS-LUBRICATED BEARINGS. Peters, Alec; Devlin, Patricia (Franklin Inst. Research Labs., Philadelphia, Pa.). Nov. 1965. Contract Nonr-2342(00). 213p. (I-A2049-25). Dep. mn; CFSTI $6.00 cy, $1.50 mn.

References (493) are given to reports, journals, books,

and patents published from January 1961 through Dec. 31, 1964. Author, corporate author, subject, and patent indexes are included. (P.C.H.)

7224 HOT CELLS FOR INTERMEDIATE AND HIGH ACTIVITIES. Boehme, G. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.); Stephan, W. Kerntechnik, 7: 533-8(Dec. 1965). (In German).

The construction and basic equipment of hot cells are described and illustrated. The precautions used to prevent the spread of contamination are indicated. The remote-control equipment used in mechanical processing, material testing, and metallography are described. (J.S.R.)

7225 THE LEAD CELL LABORATORY 1 OF THE INSTITUTE FOR REACTOR MATERIALS OF THE NUCLEAR RESEARCH ESTABLISHMENT, JUELICH. Stephan, W. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 7: 542-5(Dec. 1965). (In German).

The laboratory and the precautions taken against the movement of contamination are described. Individual hot cells and their pertinent devices are considered. (J.S.R.)

7226 TWO-PIECE REPLACEABLE GASTIGHT UTILITY PLUGS FOR THE WALLS OF HOT CELLS. Nievelstein, M.; Csiba, L.; Hellwig, H. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 7: 555-7(Dec. 1965). (In German).

The constructional requirements for two-piece replaceable gas-tight utility plugs are described. The technique for replacing the plugs is discussed. (J.S.R.)

Heat Transfer and Fluid Flow

See also PHYSICS — Fluid Physics and Thermodynamics

Refer also to abstracts 7047, 7221, 7501, 8327, 8336, 8344, and 8396.

7227 (EURAEC-1283) LARGE SCALE EXPERIMENTS ON HEAT TRANSFER AND HYDRODYNAMICS WITH STEAM-WATER MIXTURES—PHASE AND VELOCITY DISTRIBUTION MEASUREMENTS IN A ROUND VERTICAL TUBE. Topical Report No. 3. Adorni, N.; Peterlongo, G.; Ravetta, R.; Tacconi, F. A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct. 1964. Contract 056-62-1-RDI. 83p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Measurements of phase and velocity distribution with steam-water mixtures in vertical upflow, in the core region of a cross section of a vertical round tube, are presented. The pressure was 51 kg/cm^2 abs; the tube diameter 2.5 cm. A probe was used both as a Pitot tube and for isokinetic sampling; the probe was located at the downstream end of a 160 cm section which could either be heated or not so as to show the influence of heat transfer. Measurements of pressure drop, heat transfer coefficient, and critical power input were also performed with the same test element. (auth)

7228 (GEAP-4963) TRANSITION BOILING HEAT TRANSFER PROGRAM. Eleventh Quarterly Progress Report, July–September 1965. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Oct. 1, 1965. Contract AT(04-3)-189. 29p. (EURAEC-1525). Dep. mn; CFSTI $2.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Heat transfer data were obtained with the new three-rod assembly at 60 test conditions. Two different smooth rod geometries were tested. Results were obtained with one geometry at three pressures and three mass velocities. The critical heat flux was found to occur on the part of the heated rods facing other heated surfaces before spreading to areas facing the unheated channel. Partial heat transfer results are presented which show trends similar to the one-rod data. Fully-developed film boiling coefficients for several flow conditions are presented. The design of a three-rod observational test section was completed and fabrication is underway. (auth)

7229 (KAPL-3027) HYDRODYNAMIC STABILITY ANALYSIS. Feingold, D. A. (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 20, 1964. Contract W-31-109-eng-52. 50p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Experiments show that large flow oscillations can exist in a heated flow channel. Oscillations of this type can result in element damage, through either element fatigue or a breakdown in the heat-transfer mechanism. The analysis presented, which predicts the conditions necessary for flow oscillations, consists of a linearized frequency solution of the continuity, energy, and momentum equations combined with the equations of state and the necessary empirical correlations. By comparison with experimental data, the analysis demonstrates its capability to predict the natural frequency and relative stability of the channel flow. (auth)

7230 (R63CAP67) DNB HEAT FLUXES IN AN ANNULAR TEST SECTION FOR A TERPHENYL COOLANT CONTAINING 30 percent HIGH BOILERS. Rogers, J. T.; Barns, G. M. (Canadian General Electric Co. Ltd., Peterborough (Ontario). Civilian Atomic Power Dept.). June 1965. 62p. Dep. mn.

Sub-cooled, forced-convection DNB (departure from nucleate boiling) heat fluxes for Santowax OM plus 30% high boilers were measured in annular test sections, $d_e = 0.234$ inches, with vertical upward flow. For valid DNB runs, an entrance-length effect on DNB heat flux was detected, which essentially disappears at $L/d_e = 60$. DNB heat fluxes measured in the 14- and 22-inch-long annular test sections agreed very well with those reported by others for 15-inch-long tubular test sections using Santowax R with 35% total high boilers. It was found that the recommended correlation, or similar correlations for other organic coolants, cannot be applied to predict failure heat fluxes with organic coolants in complex-geometry test sections in which the failure mechanism is either localized DNB or coke-out. Use of DNB heat fluxes obtained in simple geometry test sections to predict the failure heat fluxes of organic-cooled fuel may lead to unsafe designs. (P.C.H.)

7231 (TID-22465) BASIC STUDIES IN GAS-SOLID SUSPENSION. Quarterly Report No. 65-3, June–August 1965. Peskin, Richard L. (Rutgers–The State Univ. of New Jersey, New Brunswick. Bureau of Engineering Research). Nov. 1, 1965. Contract AT(30-1)-2930. 12p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Results are given of fluid mechanics studies directed primarily at solids density profile investigations, turbulent structure investigations, heat transfer experiments and heat transfer mechanism studies obtained from experimental conclusions, thermal plate-out investigations, studies of diffusion in suspensions, and gas dynamic and thermodynamic cycle studies. (W.L.G.)

7232 (WCAP-5480) FORCED CONVECTION HEAT TRANSFER TO SUPERHEATED STEAM AT HIGH PRESSURE AND HIGH PRANDTL NUMBERS. Bishop, A. A.; Krambeck, F. J.; Sandberg, R. O. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). [1963]. Contract AT(30-1)-2948. 24p. (CONF-651110-2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From American Society of Mechanical Engineers, Annual Winter Meeting, Chicago.

Experimental data were obtained over a wide range of parameters for forced convection heat transfer to saturated and superheated and steam flowing through cylindrical tubes. The experimental pressure range was 2390-3120 psia, the Prandtl number range was 0.9 to 6.0, and the mass flow rate was 0.49 to 2.4×10^6 lb/hr ft^2. The data were correlated using fluid properties evaluated at the bulk fluid and at the film temperatures. Superheated steam data at 1000 to 3000 psia from other sources were found to give a good fit to either correlation. (auth)

7233 (BNL-tr-26) THE AVERAGE PRESSURE DROP IN VAPOR GENERATORS AND LOW PRESSURE

CONDENSERS. Kirillov, P. L. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Tekhnicheskii Institut). Translated by Stephen Amoretty (Brookhaven National Lab., Upton, N. Y.). 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf.

A new expression for the mean pressure drop was obtained in which the coolant temperature and temperature drop will not vary exponentially. This applies to both low pressure vapor generators and condensers. (P.C.H.)

7234 UPWARDS ANNULAR TWO-PHASE AIR/WATER FLOW IN VERTICAL TUBES. Willis, I. J. (General Electric Co., Ltd., Kent, Eng.). Chem. Eng. Sci., 20: 895-902(Oct. 1965).

The form of the velocity profile was investigated in upwards annular two-phase flow analytically assuming laminar flow and using the shear stress distribution as the starting point. The point at which the onset of downflow in the liquid film occurs is defined. It is shown that laminar analysis describes with a reasonable degree of accuracy the liquid film motion. The validity of the velocity profile derived directly from the shear stress distribution assuming laminar flow was supported by data. (M.C.G.)

7235 CONTACT AREA OF BOILING BUBBLES ON THE HEATING SURFACE. Torikai, Kinichi; Yamazaki, Toshi. Nippon Kikai Gakkai Rombunshu, 31: 440-9(Mar. 1965). (In Japanese).

In the investigation of the mechanism of boiling heat transfer and of the burnout, it is important to study the contact area of boiling bubbles on the heating surface. Experiments were performed in the case of the horizontal, upward boiling from a flat plate in atmospheric-pressure water, using an electroconductive glass. Observations were made on the contact area, from the side opposite to the heating surface. The results obtained are as follows: bubbles, formed on the heating surface, coalesce with one another, as well as with those already separated. At a high heat flow, the size of these bubbles is larger than those of independent bubbles, but their formation is less frequent than the independent ones; it appeared as the film boiling was occuring at the place where bubbles coalesced. It was also found that the ratio of the contact area in the burnout to the whole surface area was about 50%. (NSA of Japan)

7236 VARIATION OF BOILING HEAT TRANSFER WITH GENERATION OF BUBBLES. Torikai, Kinichi; Yamazaki, Toshi. Nippon Kikai Gakkai Rombunshu, 31: 450-7(Mar. 1965). (In Japanese).

The experiments in which water was boiled by platinum wire electric heating are described. The bubble formation and variation of the temperature of the wire were measured by an oscillograph and high-speed camera. The results obtained are as follows: (1) there is no temperature change when bubbles are not produced. (2) Immediately upon the formation there is a rapid temperature decrease. (3) As the bubbles separate from the platinum wire, the temperature rises again to the initial temperature. When the liquid temperature was lowered, the platinum wire was heated below the saturation temperature, and air bubbles, having the same growth as the boiling bubbles were attached to the platinum wire, it was observed that the temperature of the wire was not changed while the bubbles adhered and grew, and was somewhat decreased as they were separated. But, when the platinum wire was heated up to the saturation temperature, the wire temperature was decreased, as in the case of the boiling bubbles. It was thus concluded that the adhering bubbles give a large influence on the heat transfer. (NSA of Japan)

7237 SPHERICAL BUBBLE COLLAPSE IN UNIFORMLY SUBCOOLED LIQUID. Akiyama, Mamoru (Tokyo Univ.). Nippon Kikai Gakkai Rombunshu, 31: 458-69(Mar. 1965). (In Japanese).

The rate of collapse of spherical bubbles in a uniformly subcooled liquid is calculated and the results are compared with the experimental values for atmospheric pressure water. The collapse of spherical bubbles in subcooled liquids, its nondimensional equation, and the effect of dissolved gases are treated. As the result, the regions of the asymptotic stage and the locus of the inflection point are made clear, and the possibility of the volumetric vibration is confirmed. The exact comparison with the theoretical analysis was not possible, but the rates of collapse were in good agreement with the theoretical values. (NSA of Japan)

7238 HEAT EXCHANGER DESIGN. Fraas, Arthur P.; Ozisik, M. Nechati. New York, John Wiley and Sons, Inc., 1965. 390p. $17.50.

Problems in the design, selection, testing, and installations of heat-transfer equipment, including shell-and-tube, finned tube, plate-fin, plate-coil, and pebble-bed heat exchangers, and condensers, space radiators, and cooling towers, are considered. Design and analysis techniques are illustrated for sixteen cases. Charts, tables, photographs, and drawings are presented. (M.C.G.)

7239 BOILING HEAT TRANSFER AND TWO-PHASE FLOW. Tong, L. S. New York, John Wiley and Sons, Inc., 1965. 255p. $14.00.

The present state of knowledge about boiling heat transfer and two-phase flow is reviewed. Emphasis is on boiling crisis and flow instability. Pool boiling, hydrodynamics of two-phase flow, pressure drop of two-phase flow, flow boiling, flow boiling crisis, and instability of two-phase flow are discussed. (M.C.G.)

Materials Testing

Refer also to abstracts 7338, 7469, 8322, and 8326.

7240 (ANL-7089) STRESS ANALYSIS OF REINFORCED CIRCULAR AND RECTANGULAR FLAT PLATES. Chen, James L. S.; Lai, Chia-shing; Moen, Donald A. (Argonne National Lab., Ill. Associated Midwest Universities, Lemont, Ill.). Aug. 1965. Contract W-31-109-eng-38. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A set of mathematical models is constructed for applying orthotropic plate theory to the case of plates with attached ribs or stiffeners. The procedure for obtaining an optimum design of plates is given for a desired deflection limitation. Two sets of computer programs, one for applying simple beam theory to the deflection of plates as an approach, and the other for orthotropic plate theory, are written in FORTRAN II language to determine the optimum cost. A numerical example is executed by an IBM-1620 computer. The results indicate that the two approaches are in reasonable agreement. (auth)

7241 (COO-1477-2) DEVELOPMENT OF TEST PROCEDURES—FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSEL STEELS. Period Covered: August 1, 1965-October 31, 1965. Ripling, E. J.; Crosley, Phillip (Materials Research Lab., Inc., Richton Park, Ill.). Nov. 30, 1965. Contract AT(11-1)-1477. 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Because of the inherent difficulties in measuring the fracture toughness of mild steel, basic information needed for designing double cantilever beam testing specimens can best be obtained from tests on other materials. Work to date has concentrated on epoxy and 7075-T651 aluminum, from which specimens can be inexpensively prepared and for which plane strain crack propagation can be obtained in small specimens. From these studies the effects of different design parameters on the crack propagation direction and on crack arrest capability of the specimen were determined. Specimen shapes were developed in which the load required to initiate rapid fracture is independent of the crack length, a feature that makes fracture toughness testing both easier and more reliable. (auth)

7242 (LA-DC-6977) A SPECIALIZED X-RAY GENERATOR FOR RADIOGRAPHING CIRCUMFERENTIAL WELDS IN SMALL DIAMETER TUBES. Edenborough, Neville B.; Sattler, Frank J.; Tenney, Gerold H. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 24p. (CONF-651021-2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 25th National Convention of the Society for Nondestructive Testing, Detroit.

Heat exchangers in many reactors contain circumferential welds which, owing to the overall geometry, cannot be radiographed satisfactorily with commercially available sources of radiation. This problem was encountered in connection with the development of the Ultra High Temperature Reactor Experiment (UHTREX) and of the Core Test Facility. The characteristics and performance of the x-ray generator are described. It has a 9-in.-long, $\frac{3}{8}$-in.-diameter anode extension that produces a 360° reflected x-ray beam. This generator can be operated up to 75 kv and at an intensity of 50 microamperes. Radiographs reveal 4-mil-diameter voids in a 125-mil-thick specimen. In the field, this unit was used to radiograph welds in 0.1-in.-thick, 1.5-in.-OD stainless steel tubes. (P.C.H.)

7243 NEUTRON RADIOGRAPHY IN FIELD USE. Warman, Edward A. (General Dynamics Corp. Groton, Conn.). Mater. Eval., 543-51(Nov. 1965).

Some of the basic aspects of neutron radiography are reviewed, with particular emphasis on the physics of this nondestructive testing method. The results of an experimental evaluation program are presented, which show that isotopic antimony-beryllium photoneutron sources can be used for neutron radiographic applications. This program provided information regarding neutron moderation and beam collimation requirements. Based on this experimental evidence, a portable device was designed. It employs a portable radiographic camera, with an antimony-beryllium photoneutron source, in conjunction with a neutron moderator and beam collimator configuration. This development makes available, for the first time, a means of obtaining economical inspection neutron radiographs in field application usage. (auth)

7244 AN INVESTIGATION ON THE EFFECT OF ELEVATED TEMPERATURES ON CONCRETE FOR REACTOR VESSELS. Campbell-Allen, D. (Univ. of Sydney); Low, E. W. E.; Roper, H. Nucl. Struct. Eng., 2: 382-8(Oct. 1965).

Cycles of temperature up to 300°C were applied to concrete made with normal Portland cement and dolerite aggregate. Progressive loss of compressive and tensile strength was observed, combined with very large reductions of elastic modulus. Some of the effects are due to changes in the aggregate which affect aggregate stiffness and the bond with the cement paste. Conclusions are drawn in regard to suitable aggregates for operation at elevated temperature. (auth)

7245 ELEVATED-TEMPERATURE TESTING OF METALS. Second Edition, Revised and Enlarged. Borzdyka, A. M. New York, Daniel Davey and Co., Inc., 1965. 424p. $16.50.

Translation of Metody Goryachikh Mekhanicheskikh Ispytanii Metallov.

The basic problems common to all types of high temperature tests are discussed. These problems include: methods of heating, temperature control and measurement, and determination of small deformations. The various high-temperature testing methods, their specific features, equipment used, and typical test results are described. (W.L.G.)

Protective Structures

Refer also to abstract 7358.

7246 (GA-6697) SAFE-AXISYM—A COMPUTER PROGRAM FOR THE DESIGN OF COMPOSITE BODIES OF REVOLUTION INPUT INSTRUCTIONS. Cornell, D. C. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Oct. 15, 1965. Contract AT(04-3)-167. 37p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The input procedure for the program is given. The program is written in FORTRAN IV for use with the IBM 7044 computer. SAFE-AXISYM is oriented for the analysis of heterogeneous structures such as reinforced and/or prestressed concrete. (W.L.G.)

Space Propulsion

See also **ISOTOPE TECHNOLOGY — Power Application**
REACTOR TECHNOLOGY — Propulsion and Space

7247 (D-910093-19) ANALYTICAL STUDY OF HYDROGEN TURBOPUMP CYCLES FOR ADVANCED NUCLEAR ROCKETS. McLafferty, G. H.; Michels, H. H.; Latham, T. S.; Roback, R. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sept. 1965. Contract NASw-847. 80p. CFSTI.

An analytical study is conducted to determine the characteristics of three different turbopump cycles that might be employed to obtain the high engine inlet pressures that are expected in advanced nuclear rockets. The three cycles considered are: a topping cycle, in which the power required to drive the pump is obtained by passing all of the pump-exit flow through a turbine before this flow enters the engine; a bleed cycle, in which all of the pump power is obtained by discharging a fraction of the pump-exit flow through a bleed turbine with an expansion pressure ratio of 0.01; and a mixed cycle, in which half of the power to drive the pump is obtained from a primary turbine and half from a bleed turbine. The studies were conducted for turbine inlet temperatures between 1400 and 3800°R, for turbine inlet pressures between 200 and 5000 atm, for pressure drops between the pump exit and the turbine inlet of zero and 50 atm, and for three different combinations of pump and turbine efficiency. The results of the study include the effect of engine inlet pressure on the turbine pressure drop and/or the bleed flow fraction for each cycle. Studies not connected with hydrogen turbopumps are also described. These are: an analysis of the approximate temperature distribution in the fuel-containment region of a coaxial-flow gaseous nuclear rocket; a change in form of heavy-gas containment data obtained from NASA Lewis coaxial-flow tests; and an analysis of the heat generation rate in fuel passing through a fuel-injection duct located in the moderator of a gaseous nuclear rocket engine. (auth)

7248 (AD-620856) METHOD OF OBTAINING A NEUTRALIZED ION BEAM FROM A PLASMA SOURCE WITH THE AID OF A HIGH FREQUENCY ELECTRIC FIELD. Kuzovnikov, A. A.; Golovanivskii, K. S. Translated from Russian Patent No. 167582. Feb. 25, 1964. 3p. (FTD-TT-65-498). CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf.

In the described method, neutralization of an ion beam from a high frequency plasma source is attained by feeding high frequency and d-c voltage to the accelerating electrode relative to the plasma source. (M.O.W.)

7249 SPACE PROPULSION. Turcotte, Donald L. A Blaisdell Paperback Book in the Pure and Applied Sciences. New York, Blaisdell Publishing Co., 1965. 146p. $2.50.

It is shown how the fundamental physical and chemical laws place limitations on vehicle performance and influence the selection of propulsion systems for specific mission requirements. The concept of thrust is introduced, and the laws of mechanics are used to determine the performance of space vehicles for either chemical or nuclear propulsion with or without gravitational fields. Chemical propulsion systems are considered including both liquid and solid propellant designs. Nuclear propulsion systems are treated, and electric propulsion devices combined with a nuclear reactor are considered. Finally, photon propulsion and solar sailing are discussed. (J.F.P.)

Vacuum Engineering

Refer also to abstract 7415.

7250 GENERAL STUDY OF CRYOPUMPING. Rousel, J.; Thibault, J.-J.; Nanoboff, A. (Centre d'Etudes

Cryogeniques, Sassenage, France). Vide, 20: 249-80 (July-Aug. 1965). (In French).

The fundamentals of vacuum technique (pressure, flow rate, conductance of vents and pipings) are summarized and the pumping rate of an ideal cryopump is defined. A description is given of the influence on that theoretical pumping speed of various parameters, such as the accommodation coefficient, the time during which the gas is retained on the walls, the probability for molecules to permeate through optically opaque baffles, the capture coefficient of gases on the cryosurface. The case of cryopumping in the viscous state is particularly discussed. 64 references. (auth)

GEOLOGY, METEOROLOGY, AND MINERALOGY

General

Refer also to abstract 7375.

7251 (VUF–1026) ANALYSIS OF GROUND MOTION AND CONTAINMENT. SALMON EVENT, PROJECT DRIBBLE. Final Report. (Beers (Roland F.), Inc., Alexandria, Va.). Aug. 26, 1965. Contract AT(29-2)-1163. 176p. (NVO–1163-59). Dep. mn; CFSTI $5.00 cy, $1.25 mn.

Predictions and evaluations of ground motion, stemming, containment, and physical effects of ground motion on subsurface facilities and aquifers were made for the Salmon event. These predictions were compared with observed data where available. Analysis of seismic records included corrections for instrument response and the derivation of nonrecorded motions by differentiation and integration. The observed ground motions along the instrumented lines to the east and south compared favorably with predictions but records from other stations indicate that large azimuthal variations in ground motions occurred. Additionally, uncertainty exists concerning amplitude of motions owing to lack of complete low frequency measurements. The prediction of containment and the evaluation of the adequacy of the stemming plan were substantiated by the test results. Available post-shot data permitted several quantitative comparisons. (P.C.H.)

7252 THE OMEGATRON: A USEFUL TOOL FOR ARGON ISOTOPE INVESTIGATION. Grasty, R. L.; Miller, J. A. (Cambridge Univ., Eng.). Nature, 207: 1146-8(Sept. 11, 1965).

A description is given of the operating characteristics and performance of an omegatron device for argon isotope determination in gas samples obtained from whole-rock or separated minerals. A typical scan of atmospheric argon mixed with argon-38 spike shows complete separation. The results obtained from many determinations of the atmospheric argon isotope ratios were $^{40}Ar/^{36}Ar = 295.6 \pm 1.5$ and $^{36}Ar/^{38}Ar = 5.26 \pm 0.06$, which agree favorably with those obtained by Nier. (L.B.S.)

7253 IRON MINERALS FORMED BY A NUCLEAR EXPLOSION IN A SALT BED. Nathans, M. W. (Tracerlab, Richmond, Calif.); Smith, D. K.; Kahn, J. S. Science, 150: 1027(Nov. 19, 1965). (UCRL–14206).

The nuclear event, Gnome, was carried out in halite in the Salado formation and yielded a varied mineral assemblage. The iron support members reacted in the salt melt and formed several iron oxide phases. The magnetite formed during the fireball stage reacted in various ways with the environment to form higher oxides and hydrated oxides. (auth)

7254 ADVANCES IN GEOPHYSICS. VOLUME 11. Landsberg, H. E.; Van Mieghem, J. (eds.). New York, Academic Press, 1965. 358p.

Terrestrial meteoritic craters and the origin of tektites are considered. A literature survey of tektites and the theory of their origin, the backsplash jet hypothesis of tektite formation, and the Ries Kessel and other craters are discussed. A general picture of atmospheric ozone is presented with special attention to the new aspects of the question. The heat and water budget of the earth's surface is treated. The earth's surface as the locale of the heat and water balances, individual fluxes, storages, and transformations in the heat and water balances, and the earth's heat and water resources are discussed. The fluctuations in ground-water levels is considered including fluctuations in large aquifers replenished by precipitation or artificial recharge, and fluctuations in alluvial aquifers recharged by or discharging into watercourses with changing level. (J.F.P.)

Natural Radioactivity and Fallout

See also HEALTH AND SAFETY

Refer also to abstracts 7333–7335.

7255 (TID–22411) ANNUAL REPORT [ON FALLOUT IN SEA WATER]. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). [1965]. Contract AT(30-1)-2663. 82p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Five articles are included; separate abstracts were prepared for each one. (P.C.H.)

For abstracts of individual papers see: 7256–7260.

7256 (TID–22411, App.A) THE VERTICAL DISTRIBUTION OF ^{137}Cs AND ^{90}Sr IN THE OCEANS. [PART] II. Broecker, Wallace S.; Bonebakker, Erno (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory); Rocco, Gregory G. (Tracerlab, Inc., Waltham, Mass.). 18p.

Further data are presented in support of previous conclusion that the vertical distributions of ^{137}Cs and ^{90}Sr are in accord with the slow ocean mixing rates demanded by the distribution of natural radiocarbon in the sea. As of early 1963 no significant activity appears to have penetrated below 500 meters in either the North Atlantic or equatorial Pacific Oceans. A method for shipboard separation of Cs and Sr from 200 liter batches of sea water is outlined. (auth)

7257 (TID–22411, App.B) COMPARISON OF OCEANIC AND LAND FALLOUT RATES. Broecker, Wallace S. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory); Rocco, Gregory G. (Tracerlab, Inc., Waltham, Mass.); Volchok, H. L. (Health and Safety Lab., New York Operations Office (AEC), N. Y.). 11p.

Measurements of ^{90}Sr in waters residing on the Bahama Banks for periods between 12 and 180 days suggest that fallout rates onto these waters are substantially the same as those measured for the average of all fallout collection stations in the 20° to 30° North latitude band. Assuming that the amount of precipitation in the Bahama Banks region is reasonably representative of the oceanic areas in the latitude band, the results support the conclusion that the amount of ^{90}Sr deposition per unit area of oceanic surface is within a factor of two of that on land. (auth)

7258 (TID–22411, App.C) RADIOISOTOPES AND THE RATE OF MIXING ACROSS THE MAIN THERMOCLINES OF THE OCEAN. Broecker, Wallace S. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). 29p.

A box model of oceanic mixing is presented which permits the distribution of long lived natural radioisotopes (^{14}C, ^{226}Ra, ...) to be quantitatively compared with that of those made by man (^{90}Sr, ^{137}Cs). Results of calculations using this model show that the distributions of ^{14}C and of ^{90}Sr-^{137}Cs are internally consistent. Both suggest a several-fold higher transfer rate across the main thermocline of the Atlantic than in the Pacific Ocean. Not only the vertical distribution of ^{90}Sr and ^{137}Cs in the upper 800 meters of the oceans is consistent with mixing rates dictated by ^{14}C but also the absolute amounts are consistent with those found in soils. The finding that ^{226}Ra shows the same fourfold increase from the warm to cold reservoir of the Pacific Ocean as barium strongly suggests that this isotope is currently not of use in establishing oceanic mixing rates. (P.C.H.)

7259 (TID–22411, App.D) THE VERTICAL DISTRIBUTION OF ^{226}Ra IN THE NORTHWESTERN PACIFIC OCEAN. Broecker, Wallace S. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). 16p.

The distribution of ^{226}Ra in sea water was studied. As a result a shipboard method for ^{226}Ra measurement was de-

veloped, and a detailed ^{226}Ra concentration profile for the Pacific Ocean was obtained. The ^{226}Ra content was found to be nearly uniform at 4×10^{-14} g/l down to 500 m. A smooth increase occurs downward through the main oceanic thermocline reaching a value of 13×10^{-14} at 2000 m. Below this level, a small increase occurs, the concentration approaching 16×10^{-14} g/l at the bottom. It was concluded that at the present ^{226}Ra has little value as an oceanic tracer. (P.C.H.)

7260 (TID-22411, App.E) UNSUPPORTED ^{228}Ra AND ^{228}Th IN SEA WATER. Moore, Willard S. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). 7p.

Studies were made to determine if excess ^{228}Th is supported in the ocean by ^{228}Ra, its parent (half life 6.7 yr). Analytical techniques for measuring all radium and thorium isotopes in the water were devised. The results showed ^{228}Th to be in excess in all samples regardless of method of collection. ^{228}Ra was not detected in waters 1000 m below the surface and 1000 m above the bottom, but ^{228}Th was. It was concluded that if ^{228}Ra is not supporting ^{228}Th in this region then a very short time scale of removal of thorium from surface water would be indicated. (P.C.H.)

7261 THE DISTRIBUTION OF DEUTERIUM IN PETROLEUM DEPOSITS. Blaga, Liviu; Blaga, Lucia; Chifu, Alexandra; Ciobotaru, Tamara (Inst. of Atomic Physics, Cluj). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 639-47(1965). (In Rumanian).

Five petroleum deposits lying in rocks of varying geological ages were systematically examined in order to determine the distribution of deuterium in the fluids present. It was expected that the result will reflect the distribution under natural conditions, unaffected by drilling operations. Crude oil, natural gas, and water samples were collected at various locations, chosen to cover the whole area of the deposit. The gas was sampled only if its pressure exceeded 6 atm. After standardizing the ^{18}O content with SO_2, the oil and gas samples were burned in oxygen; the water was purified until its conductivity was between 10^{-6} to 10^{-7} ohm^{-1} cm^{-1}. The ^{18}O content of the samples was determined by a total isotopic analysis. The results were expressed in density differences of γd (1 γd = 0.000927 mole % D_2 and 0.00087 mole % $^{18}O_2$). It was found that gas samples had the lowest D content, varying between -0.5 and -1.9 γd; in the crude oil the D content varied from -0.1 to -0.13 γd. The water samples exhibited the highest D concentrations, ranging from +0.3 to 1.1 γd. These data agreed with the results of calculations based on the partition coefficients of the hydrogen isotopes between methane, ethylene, and water. The D content of the crude oil was found to increase toward the center of the deposit, revealing the existence of mass transfer within the oil, which reached a steady state. The accumulation of D toward the center could be due to a geothermic gradient, an increase of the saturation pressure of the gases, or isotopic equilibrium at the water-oil and gas-oil interfaces. (TTT)

7262 THE THORON-CONTENT OF ATMOSPHERIC AIR NEAR GROUND LEVEL. Jacobi, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Atomkernenergie, 10: 471-8(Nov.-Dec. 1965). (In German).

A double-filter-device is described, which allows a simultaneous measurement of the Tn- and ThB-concentration in atmospheric air in presence of Rn. The measured variation of the Tn- and ThB-concentration in air in two different altitudes near ground level is presented in connection with the corresponding meteorological parameters. It results in a mean Tn-concentration of 440 pC/m^3 in 0.2 m and of 160 pC/m^3 in 2 m altitude, compared with a mean ThB-concentration of 2 pC/m^3 in this air layer. From the results follows a mean Tn-exhalation rate from ground of about 50 Tn-atoms/$m^2 \cdot$ sec. Furthermore from the measured vertical gradient of the Tn-concentration the mean vertical profile of the turbulent mixing rate in the air layer near ground level can be derived. The corresponding mean vertical distribution of Tn and ThB is computed; it agrees with the experimental results. (auth)

7263 RADIOACTIVE FISSION PRODUCTS FROM NUCLEAR EXPLOSIONS AND THEIR INCORPORATION. Sommer, J. (Ministerrat der Deutschen Demakratischen Republik, Rossendorf-Dresden). Deut. Stomatol. 15: 142-52(Feb. 1965). (In German).

Following a nuclear explosion the residual radiation present is caused by a wide range of fission radionuclides, neutron-induced radioactivity, and intact nuclei of fissionable material. The radionuclides produced enter into the biocycle as local and world-wide fallout from the stratosphere and atmosphere. The radioactive fallout may be inhaled or ingested by man. One of the major fallout products, ^{90}Sr is more strongly retained by soil than is Ca so that the resulting concentrations in foodstuffs are somewhat less than in the soil surface. The soil-plant discrimination factor has been estimated to be 0.2, and for the dilution in milk it has been estimated to be 0.05. Under fallout conditions in East Germany the discrimination factor between soil and skeleton has been calculated to be 0.1. For the yr 1958 and 1959 the concentrations of pC ^{90}Sr/g Ca were 1.2 and 1.9 for infants, 1.4 and 2.2 for children up to age of 5 yr, 0.5 and 0.8 for children from 5 to 20 yr, and 0.1 for each of these yr in the population older than 20 yr. The irradiation received from ^{90}Sr incorporated in man is less than the variations in terrestrial and cosmic irradiation in various areas of the earth. Probably, there are no long-term biological effects of ^{90}Sr that can be measured. (BBB)

7264 ON THE CORRELATION OF THE ZIRCONIUM, HAFNIUM, URANIUM AND THORIUM IN ACCESSORY ZIRCONS FROM GRANITOIDS OF THE MIDDLE DNIPER AREA. Orsa, V. I. (Inst of Geology, Academy of Sciences, Ukrainian SSR). Dopov. Akad. Nauk Ukr. RSR, No. 10, 1348-52(1965). (In Ukrainian).

Zircons from three groups of granitoid rocks of the Dnieper area plagiogranites, granodiorites, migmatites (group 1), and grey granites of the Mokromoskovsky massif (group 2) and red pegmatoid granites (group 3) are characterized by close values of the ratio Zr/Hf. Zircons from the third group of the rocks are distinguished by a high thorium content. A relation between Hf and U was established for the zircons of the first group. (auth)

7265 MEASUREMENT OF BACKGROUND RADIATION IN LAKES. Likens, Gene E. (Dartmouth Coll., Hanover, N. H.). Ecology, 46: 544-7(Early Summer 1965).

Measurements of background radiation were made in five lakes in Wisconsin, New Hampshire, and the Antarctic. Data collected with a portable scintillation detector showed that the amount of ionizing radiation varied greatly with vertical position in the lakes. Relatively high count rates were found near the surface and bottom of the water column whereas the middle was characterized by a very low background of radioactivity. Higher count-rate values were usually recorded near shore. In situ measurements utilizing a water shield showed that the increase in count rate near the surface was apparently due to cosmic radiation whereas that near the bottom was a part of the natural background radiation emanating directly from the sediments. A radioactivity gradient within the sediments extended from the center to the shore of one lake. Measurements of ionizing radiation emanating from the sediments of the New Hampshire lakes were appreciably higher than those in the Wisconsin lakes, whereas values measured within the water column were similar. This probably resulted from differences in the inherent radioactivity of bedrock materials (granite vs sedimentary rock) and their relative distance from the mud-water interface. An energy spectrum analysis within the relatively high radiation areas revealed no conclusive evidence for the presence of any particular radionuclide. The gradient of ionizing radiation extending from shallow to deep sediments may be explained by fallout deposits from the drainage basin. In Antarctica, the measurements revealed very low count rates at depth within the water column, and the air-

background at the surface of the ice was surprisingly low. (TCO)

7266 THE RELATIVE ABUNDANCE OF THE LITHIUM ISOTOPES IN THE HOLBROOK METEORITE. Poschenrieder, Walter P.; Herzog, Richard F.; Barrington, Alfred E. (Geophysics Corp. of America, Bedford, Mass.). Geochim. Cosmochim. Acta, 29: 1193-5(Nov. 1965).

A direct determination of the abundance of the isotopes of lithium, which occurs as a trace element in the Holbrook meteorite, is reported. The measurement was performed with an ion-microprobe mass spectrometer, which permits analysis of very small portions of the meteorite surface without chemical preparation. The concentration of lithium over the sample surface was very inhomogeneous. In general it was below the detection limit (about 1 ppm); however, some spots were found where the concentration was as high as about 100 ppm. In the regions of larger concentrations the ratio of the mass-peak heights $^{7}Li/^{6}Li$ varied between 9.5 and 27.5; in a comparison sample of terrestrial hornblende it did not deviate by more than ±8%. (auth)

7267 XENON AND ARGON ISOTOPES IN THE OLDEST ROCKS OF THE EARTH. Shukolyukov, Yu. A.; Tolstikhin, I. N. (Lab. of Geology of Precambrian, Leningrad). Geokhimiya, No. 10, 1179-85(Oct. 1965). (In Russian).

The $^{36}Ar/^{38}Ar$ ratio in basic rocks did not differ from the aerial ratio. Experiments with argon isolation at different temperatures from a sample at an age of 11 billion years according to the K/Ar ratio showed that the observed amounts of ^{36}Ar and ^{38}Ar are only connected with the presence of aerial argon in the apparatus. The content and isotopic composition of xenon were determined in the same samples. In contrast to meteorites, in basic rocks of the oldest age no substantial deviation of the ^{136}Xe, ^{134}Xe, and ^{129}Xe abundances from the relative abundance of these isotopes in the air was found. (auth)

7268 ON THE RELATION OF HYDROTHERMAL URANIUM MINERALIZATION WITH PYRITE-CONTAINING ROCK. Pelymski, G. A.; Kapshirov, S. N. Geol. Rudn. Mestorozhd., 4: 77-83(1962). (In Russian).

A collection of hydrothermal U mineral deposits was examined. Pyrite was found to play the most important role in localization of mineralization. In addition, graphitized carbonaceous materials, often in combination with pyrite, had the same general effect. Rocks which were composed only partially of pyrite, such as quartz-biotite slates, had the richest pitchblende deposits immediately about the pyritization, and the pitchblende concentration was roughly proportional to the pyrite concentration. Mineralization was related to contact of seams in diabase, amphibolite, and amphibolite slates with carbonaceous slates. Granite did not induce mineralization unless it was affected by older hydrothermal processes and contained sulfides. A table is given relating the composition of various minerals with relative U content: pyrite scarn, 60 to 70% pyrite, 100% U; carbonaceous quartz, 15 to 20%, 45 to 50%; tuffite with scarn layers, 15 to 20%, 45%; scarn, 5 to 8%, 15%; quartz-biotite slates, 4 to 6%, 7%; diabase, 1 to 2%, 4%; other minerals with 0% pyrite, 0%. Correlation with other minerals, particularly Fe minerals, did not exist. Correlation with iron sulfides could be made. The cause of this correlation with pyrite content is related to a disturbance of the chemical equilibrium in the hydrotherma. (BBB)

7269 CONTAMINATION DUE TO NUCLEAR RADIATION. Kawabata, Y. (Tokyo District Meteorological Observatory). Geophys. Mag. (Tokyo), 32: 205-30(July 1964).

The extent of radioactive contamination of the atmosphere, soil, agricultural products, sea water, and marine products in Japan, caused by nuclear weapon tests, was determined. The results of observations of radioactive contamination under the auspices of the Science and Technology Agency of the Japanese Government are reported. Strontium-90 content in soil in various regions of Japan is larger in the districts along the Japan Sea coast (30 $\mu C/km^2$) than in those along the Pacific coast (10 $\mu C/km^2$). The radioactivity of rain also is higher in the Japan Sea coast districts than in those of the Pacific coast, particularly in 1961. The total radioactivity of unhulled rice was only a few $\mu\mu C$ per kg, and there was no local difference. The radioactivity is mainly concentrated in the rice bran, and almost no radioactivity was found in polished rice. Strontium activity was higher in barley and wheat than in polished rice. Distribution of ^{90}Sr in various rice tissue is discussed. Analyses carried out on the bones of persons who had died in Tokyo show Sr unit values of about 0.5 for persons of 20 years of age and less, and about 1.0 to 1.4 for persons of more than 20 years of age. Data are also provided on radioactivity of Japanese milk, rain and sea water, and various marine animals and plants. (BBB)

7270 THE ACTIVITY LEVEL OF THE SOLUBLE AND THE INSOLUBLE FALLOUT FRACTIONS IN 1964. Csupka, St. (Hygienisch-Epidemiologische Kreisinstitut, Bratislava). Kernenergie, 8: 573-6(Sept. 1965). (In German).

The activity of soluble and insoluble fallout fractions in rainwater were observed in the industrial and non-industrial regions of Western Slowaky, USSR, in 1964. A total of 241 nC/m^2 of long-lived beta activity (including 16.86 nC/m^2 ^{90}Sr and 15.46 nC/m^2 ^{137}Cs) accumulated on this territory. The soluble fraction of the fallout contained 51.3% of the total long-lived beta activity, 73.7% of the ^{90}Sr, and 44.9% of the ^{137}Cs. It is shown that radiostrontium forms mainly soluble aerosols in the atmosphere and radiocesium insoluble ones. (auth)

7271 RADIOACTIVITY OF SEA WATER AROUND KOBE HARBOR. I. Miyake, Hiroshi; Michijima, Masami (Kobe Univ. Mercantile Marine, Japan). Kobe Shosen Daigaku Kiyo, Dai-2-Rui. Kokai, Kikan, Rigaku-hen, No. 12, 123-7(Mar. 1965). (In Japanese).

Radioactivity surveys of sea water around Kobe Harbor were carried out twice a year since 1962. Radioactivity of surface water was measured by the standard method. Average value in three years was 1.03 ± 1.21 $\mu\mu C/l$. (auth)

7272 ^{90}Sr IN HUMAN BONE, 1964. Med. Officer, 113: 261-2(1965).

The results of assays of ^{90}Sr in human bone samples obtained between January and June, 1964 are reported. The results show that during the first half of 1964 there was an increase in the ^{90}Sr concentrations in bone. In children the average levels were approximately twice as high as during the corresponding months of 1963; there was also an increase, though a smaller one, over the values for the second half of 1963. These increases are due to the large-scale atmospheric nuclear tests held in the autumns of 1961 and 1962, before the partial nuclear test ban treaty was concluded. The levels are well below those specified by the Medical Research Council in 1960 as the maximum permissible 200 pC $^{90}Sr/g$ Ca for individual members of the population and 67 pC $^{90}Sr/g$ Ca for the average over the whole population. In children under five years, the average bone concentration of ^{90}Sr was 6.9 pC $^{90}Sr/g$ Ca, compared with 5.8 in the previous six months, and 3.2 in the first half of 1963. The average concentration in newborn and stillborn infants was 3.2 pC $^{90}Sr/g$ Ca, compared with 3.0 and 1.5 in the previous two periods. In the older subjects, aged between five and 19 years, the mean ^{90}Sr level rose from 1.4 and 1.7 pC $^{90}Sr/g$ Ca respectively in the first and second parts of 1963 to 2.7 in the first half of 1964. In the collection of samples special attention was to be given to areas of the country where rainfall is about average and where radioactive fallout is thus likely to be relatively high; the figures reported here do not therefore represent true averages for the whole country, which are likely to be rather lower. (TCO)

7273 THE RADIOACTIVITY OF FOODSTUFFS IN 1963. Mitt. Geb. Lebensmitteluntersuch. Hyg., 55: 341-78(1964).

Measurements are presented for milk, cheese, cereal, fruit, vegetables, fish and drinking water from a number of Swiss cantons. The results are compared with accep-

table levels published by the U. S. Federal Radiation Council. (Excerpta Med.)

7274 INVESTIGATION OF ENVIRONMENTAL FALLOUT CONTAMINATIONS, BY THE MEASUREMENT OF THE TOTAL BETA RAYS. **Oki, Iwashiro; Yoshida, Sachiko (Osaka Public Health Inst.). Osaka-Furitsu Koshueisei Kenkyusho Kenkyu Hokoku, No. 1, 29-36(Mar. 1964). (In Japanese).**

Radioactive fallout contamination was investigated in Osaka Prefecture, from September 1961 to March 1962, in rain water, river water (Yodogawa and Yamato Rivers), well water (Sayama-machi), cleaning bed water (Fuse-shi and Ebara-machi), city water (Osaka-fu), vegetables, milk, and fishes. The relationship between the total β activity of the rain water and of the city water was observed to be the activity ratio; the activity of the city water was 10^{-2} to 10^{-3} lower than that of the rain water. No clear correlation was found between the activities of rain and well water. Contamination (over 10 cps) was not detected in the sea water, fishes, milk and soil, but some was found on the surface of vegetables. The study of the data collected showed the optimum frequency and types of sampling suitable for the determination of environmental fallout contamination, from the standpoint of public health and technical limitations of β-ray measurement. (NSA of Japan)

7275 RADIOACTIVITIES OF RAIN WATER AND DUST. **Oki, Iwashiro; Yoshida, Sachiko (Osaka Public Health Inst.). Osaka-Furitsu Koshueisei Kenkyusho Kenkyu Hokoku, No, 1, 37-43(Mar. 1964). (In Japanese).**

The total β activity, γ-ray spectrum, and absorption coefficients were measured for rain water and dust collected in Osaka during the period of November 1962–December 1963. The total β activity of the floating dust was governed by that of $^{95}Zr-^{95}Nb$, and the correlation between the total β and γ activities was very high. From the γ-ray spectra of the floating dust, the energies were divided into 4 fractions: 2000–1000, 1000–600, 600–400, and 400–100 kev. The variation of these fractions with time was examined. When the total β activity of the floating dust became low, there was a tendency for the absorption coefficient for the soft components to increase and for that for the hard components to decrease. (NSA of Japan)

7276 CORRECTION OF MEASURED TOTAL BETA ACTIVITY OF FALLOUT. **Oki, Iwashiro; Yoshida, Sachiko (Osaka Public Health Inst.). Osaka-Furitsu Koshueisei Kenkyusho Kenkyu Hokoku, No. 1, 44-52(Mar. 1964). (In Japanese).**

In the measurement of the total fallout β activity (as cpm), correction for the geometry by using U_3O_8, correction for the self-absorption, and correction for the geometry and self-absorption by using the same thickness of KCl (activity of ^{40}K) as that of the sample are suggested. The study was performed to investigate relations among the activity data obtained by the three methods. Three correction factors are considered: f_g (correction factor for the geometry), f_a (correction factor for the activity absorbed before reaching the counter), and f_s (self-absorption coefficient). Beta-absorption curves in Al are given for floating dust, U_3O_8, ^{90}Sr, KCl (1000 and 1500 mg), and ^{137}Cs. The ratio of the measured activity calibrated by KCl to that calibrated by U_3O_8 is given for the floating dust collected in the autumn of 1963. Absorption coefficients of KCl and dust were measured. When f_g, f_a, and f_s are applied, using KCl as the calibration source, the measured activity of the sample is higher than the true activity. (NSA of Japan)

7277 RADIOACTIVE CONTAMINATION DUE TO FALLOUT IN FOODS. I. DATA ON FALLOUT RADIOACTIVITY OF FOODS SAMPLED IN THE PROVINCE OF PAVIA FROM NOVEMBER 1962 TO DECEMBER 1963. **Molinari, G.; Nucciotti, L. (Centro per la Rilevazione della Contaminazione Radioattiva, Pavia, Italy). Riv. Ital. Ig., 24: 285-303(May-Aug. 1964). (In Italian).**

Detailed information is given on ^{90}Sr and ^{137}Cs concentrations in 158 food samples collected from retail markets in the Pavia district in Italy in 1962 and 1963. The results show a general rise in milk levels of ^{90}Sr from about 15 pC/l in January 1963, to 33 pC/l in December 1963. Some local geographic differences were noted, e.g., in the city of Pavia the December 1963, level averaged 34.4 pC/l compared with 43.5 in Vigevano and 17.7 in Voghera. Some of these geographic differences could be attributed to differences in rainfall; thus, Voghera had lower annual precipitation (922 mm) than Pavia (1140 mm). Data are presented on the ^{90}Sr content of vegetables, fruits, cheese, milk, and drinking water in 1963. The estimated daily intake of ^{90}Sr for residents of Pavia varied from 23.8 to 44.2 pC. Comparison of these levels with those in other countries, particularly the United States, is discussed. (BBB)

7278 ^{51}Cr AS A RADIOACTVE TRACER OF COLUMBIA RIVER WATER AT SEA. **Osterberg, Charles; Cutshall, Norman; Cronin, John (Oregon State Univ., Corvallis). Science, 150: 1585-7(Dec. 17, 1965).**

The plume of the Columbia River was followed 350 kilometers to sea by measurement of its ^{51}Cr content. This radioactive tag, introduced into the river by nuclear reactors at Hanford, Washington, promises to provide a useful oceanographic tool for determining rates of transport and mixing, and fcr identifying plume waters in the presence of other sources of fresh water. (auth)

7279 CONTINUOUS MEASUREMENT OF THE CONCENTRATION OF NATURAL RADIOACTIVE GASES AND AEROSOLS. **Blanc, Daniel; Fontan, Jacques; Birot, Andre (Univ., Toulouse). Staub, 25: 287-90(Aug. 1965). (In German).**

A device for the determination of natural radioactivity is described, which permits a separate and continuous measurement of the concentration of radioactive gases (radon and thoron) and their secondary products in air. The instrument is installed on a small portable carrier so that the measurements can be made at various sites. Measurement results are given, in particular those concerning the radioactive equilibrium between gases and their secondary products in air. There is no equilibrium in the atmosphere between thoron and its secondary products. (auth)

7280 RELATIVE HUMIDITY AND LONG-LIVED RADIOACTIVITY IN THE SURFACE LAYER OF THE ATMOSPHERE. **Zier, M. (Meteorologisches Observatorium Wahnsdorf, Radebeul, Ger.). Z. Meteorol., 18: 161-2(1965). (In German).**

From January 1962 until June 1964 the β activity in Wahnsdorf was measured by precipitation of the radioactive aerosols on filters and measurement of activity after 3 days with a counter. Mean values for activity for individual years were related to the relative humidity for the testing period in 5% humidity classifications. A decrease in activity with increasing relative humidity was noted for the years 1963 and 1964; the intensity dropped to about $\frac{1}{3}$ on increasing humidity from 50% to 100%. The relation between activity and % humidity may be expressed as $A_2 = A_1 \exp [0.03(h_1-h_2)]$. Data for 1962 do not show this relation because of large amounts of fresh radioactive materials in the air because of nuclear testing. The negative correlation also appears in data for daily averages as well; data for each day in April 1963 are plotted. The explanation is offered that the relation is an example of the washout effect; maritime air masses generally contain higher concentrations of fallout and have a high relative humidity, but are lower in activity than dry continental air masses. Relative humidity then serves as a parameter for fallout concentration. (BBB)

Techniques and Equipment

7281 (NP–15164) LABORATORY EVALUATION OF GAMMA-EMITTING TRACERS FOR GROUND WATER WITH SPECIAL REGARD TO EDTA ^{51}Cr. **Knutsson, Gert**

(Chalmers Tekniska Hogskola, Goteborg (Sweden)). Mar. 1964. 27p. Dep. mn.

Studies were made to determine the lowest concentration at which ^{51}Cr-EDTA is not retarded or adsorbed in various mineralogical environments. The use of ^{51}Cr-EDTA as a reliable tracer down to 0.01 ppm was confirmed. At the concentration of 0.10 ppm and in the mineralogical types of soils tested there was no retardation or adsorption of the ^{51}Cr-EDTA complex except a slight adsorption in augite powder and an inconsiderable one in albite powder. At the concentration of 0.01 ppm ^{51}Cr-EDTA was retarded some – about 1 hr – and the recovery was about 90 to 95% in most of the tests. (P.C.H.)

7282 (NYO–10334) ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS. A Terminal Report for the Period Ending October 31, 1965. Gaudin, A. M. (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Contract AT(30-1)-956. 37p. (MITS–53). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Extensive lists are given of publications by members of the mineral engineering project on project subjects and associated topics, theses were submitted that were supported at least in part by the project and related projects, and research topics on which reports were submitted. (P.C.H.)

7283 (SC-M–65-330) INSTRUMENTATION ACCESSORIES FOR SEISMIC MEASUREMENTS. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1965. Contract AT(29-1)-789. 84p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Accessories developed to remotely control the placement and adjustment of gages used for earth motion measurements are described. (auth)

7284 NUCLEAR-GEOPHYSICAL INVESTIGATIONS OF DRILL-HOLES DURING PROSPECTING FOR COAL AND NON-FERROUS METALS. Bulashevich, Yu. P. (Inst. of Geophysics, Academy of Sciences, USSR). Acta Geophys. Polon., 13: 107-20(1965). (In Russian)

Search instruments and techniques in γ logging and related fields are discussed. The methods examined included determination of the ash content of coal deposits at the site and estimation of the Cu content of ores by activation analysis. The instruments used included a γ spectrometer with an external block, a γ source, and a NaI detector with a photomultiplier. The γ-γ logging results revealed the presence of coal, which corresponded to the lowest density and to the lowest atomic number; the ash content was indicated by results showing an element with an atomic number higher than C. The ash consisted mostly of SiO_2 and Al_2O_3. The activation technique for estimating the Cu content of ores was based on the determination of ^{66}Cu. Under geological field conditions, the presence of Al and Mn interfered with the measurements. By operating in the 0.94 to 1.14-Mev and 1.27 to 1.47-Mev ranges with a two-canal spectrometer, Cu was recorded in the first, and Mn + Al in the second range. Results in good agreement with chemical analysis were obtained with ores containing 1.20 and 18.0% Cu. (TTT)

7285 INVESTIGATION OF THE STANDING TIME INCREASES FOR RADIOACTIVE FINE-FILTERS BY THE ADDITION OF PRE-FILTERS. Przyborowski, Sieglinde (Staatliche Zentrale fuer Strahlenschutz, Berlin). Staub, 25: 291-4(Aug. 1965). (In German).

The possibility of increasing the life of filters for precipitation, of radioactive aerosols, by using inexpensive primary filters is shown. The effect of primary filters is not only manifested by a decrease in concentration, but also by changes in particle size distribution. The problem of filter life investigations and its solution by means of experiments are discussed in detail. (auth)

7286 SEVERAL POSSIBILITIES FOR THE APPLICATION OF NUCLEAR PHYSICAL METHODS OF ANALYSIS IN GEOCHEMICAL EXPLORATORY STUDIES ON ORE DEPOSITS. Saitsev, E. I.; Malyshev, V. I.; Salmin, Yu. P.; Shiryayeva, M. B.; Yakubovich, A. L. Z. Angew. Geol., 11: 180-3(Apr. 1965). (In German).

Translated from Byul. Nauchn. Tekhn. Inform., No. 3, (47): 75-80(1963). (In Russian)

The use of activation analysis for several nonradioactive elements and radiometric analysis for several-component mixtures of radioactive elements in geochemical explorations is discussed. Sensitivities for 61 elements are given and use of activation analysis for geochemical studies of 30 elements is noted. Several examples are chosen to illustrate the importance of proper selection of bombarding particles, particularly for multiple-element analysis. A table illustrates agreement of activation data with chemical and spectrophotometric analyses in the range 10^{-4}% to 4.5%. A radiometric method was developed for the simultaneous determination of U, Ra, Th, and K, using a combined β and γ detector (scintillation counters, positioned along the vertical axis in a Pb container). Determination of isotope ratios in minerals containing radioactive elements using a scintillation α spectrometer designed for field conditions is reported. The use of a Si semiconductor counter for radioactive samples is discussed, with data for resolution of the two maxima of a natural U sample using the Si counter given. (BBB)

7287 TRACE LEAD ISOTOPE STUDIES WITH GAS SOURCE MASS SPECTROMETRY [Thesis]. Whittles, Arthur Brice Leroy. Vancouver, Can., Univ. of British Columbia, 1964. 215p.

A technique devised to prepare tetramethyllead from conformable chalcopyrite deposits and ultrabasic sulfides and some initial results are described. This is a free radical technique, involving the reaction of methyl radicals with a lead mirror evaporated out of a sulfide. It appears to be capable of preparing tetramethyllead from samples containing one to two orders of magnitude less lead than previously reported for such a technique. Unfortunately, the full extent of the method cannot be utilized with present gas source mass spectrometer facilities, and only fair precision (0.4%) is possible at 10 ppM lead. Samples from the conformable chalcopyrite deposits of Mt. Isa were analyzed. The lead isotope ratios were found to be significantly different from those of the massive lead–zinc deposits. The results, interpreted with other lead and sulfur isotope data, suggest that these deposits could be the result of metal-bearing solutions entering a partially enclosed bay. Initial results for two ultrabasic deposits suggest that the lead in the sulfides is not necessarily primary. During the investigation of the gas source mass spectrometric analyses of small tetramethyllead samples, lead isotope fractionation was observed. This occurred with molecular flow into the mass spectrometer. A preliminary study suggests that such fractionation in nature is likely to be rare, except possibly in biological processes in the sea. (A.G.W.)

7288 RADIOCARBON DATING. Second Edition. Libby, Willard F. Chicago, The University of Chicago Press, 1955. 186p. $5.00.

Advances in sampling and measurement techniques for radiocarbon dating are reviewed. Topics discussed include: world-wide distribution of radiocarbon, half life of radiocarbon, preparation of the sample for measurement, measurement of the sample, and the significance of radiocarbon dates. Tables of radiocarbon dates are presented. Special equipment and chemicals for the ^{14}C sample preparation apparatus and materials for a screen-wall counter are described. (M.C.G.)

7289 THE COMPARISON OF RADIOCARBON AGES OF CARBONATES WITH URANIUM SERIES AGES. Thurber, David L.; Broecker, W. S.; Kaufman, A. (Lamont Geological Observatory, Palisades, N. Y.). 16p. (CONF-650652–11). Gmelin, AED-CONF-65-158-17.

From International ^{14}C and ^{3}H Dating Conference, Pullman, Wash.

Uncertainties in the initial $^{14}C/^{12}C$ ratio and the possibility of post-depositional contamination are problems in assignment of radiocarbon ages to carbonates. Independent age determinations of fossils based on the growth of ^{230}Th from an initial deficiency toward equilibrium with its parent ^{234}U confirmed the general validity of the assumptions used in calculating radiocarbon ages in the 3 to 25

thousand year range. A $^{230}Th/^{234}U$ age far older than that obtained by radiocarbon suggested that the finite radiocarbon age resulted from contamination by more recent carbon. Careful measurements on coral ranging from 4000 to 20,000 years old may be useful in studying secular variations in $^{14}C/^{12}C$ in the surface ocean during this period of time. (auth)

7290 THE PRESERVATION AND DATING OF COLLAGEN IN ANCIENT BONES. Krueger, Harold W. (Geochron Labs., Inc., Cambridge, Mass.). 6p. (CONF-650652-16). ORINS. Gmelin, AED-CONF-65-158-19.

From International ^{14}C and ^{3}H Dating Conference, Pullman, Wash.

The preparation of bone samples for ^{14}C dating of either the carbonate or collagen fraction, or both, is described. Dates on the collagen content of the bones are almost always reliable within their archeological context. Collagen is recoverable from bones as old as 40,000 yr when the bones have been preserved under circumstances that do not favor oxidation. Dates on the carbonate portion of bones which have not been significantly altered are generally reliable but dates on altered bones will provide only a minimum age. (C.H.)

Thorium and Uranium Minerals

7291 URANIUM IN SEDIMENTS [Thesis]. Rosholt, John Nicholas Jr. Coral Gables, Fla., Univ. of Miami, 1963. 223p.

An oceanographic approach is used to study the distribution of abnormal occurrences of uranium in sediments. These occurrences predominate in marine phosphorites, black marine shales, and deposits in terrestrial-fluvial sandstones and ancient conglomerites. In early Paleozoic times, marine shales accounted for the majority of uranium deposition. By the beginning of tertiary time, the balance had shifted to predominant deposition in marine phosphorites, which continued to the present. Much smaller total quantities of uranium are associated with terrestrial sandstones and ancient conglomerates, although its concentration is greater and its economic recovery is more feasible. All the abnormal occurrences fit into a unique niche in the hydrologic cycle, and emplacement was largely controlled by cycles of organic substances in water. Radiochemical analyses of ^{231}Pa, ^{230}Th, and ^{226}Ra were made on a few hundred samples from sandstone-type uranium deposits. These results, in comparison to the uranium content of samples, indicate that much of the uranium in terrestrial sediments is presently in a slow, continual state of migration toward the ocean. (Dissertation Abstr.)

7292 EKZOGENNYE EPIGENETICHESKIE MESTOROZHDENIYA URANA. USLOVIYA OBRAZOVANIYA. (Exogenic Epigenetic Deposits of Uranium. Formation Condition). Batulin, S. G.; Golovin, E. G.; Zelenova, O. I. (and others). Moscow, Atomizdat, 1965. 324p.

Concepts of epigenetic processes in hypergenetic zones, geochemistry and crystal chemistry of uranium compounds are discussed. Association of non-oxidized uranium minerals in the epigenetic deposits and uranium in the surface and underground waters are described. A classification of uranium deposits is given. Uranium deposit oxidation in oil-bearing and carbonate rock is discussed. Surface uranium accumulations in dry climates and the zone of epigenetic deposits are also considered. Extensive references are included. (R.V.J.)

HEALTH AND SAFETY

See also BIOLOGY AND MEDICINE — Radiation Hazards and Protection
GEOLOGY, METEOROLOGY, AND MINERALOGY — Natural Radioactivity and Fallout

Refer also to abstracts 6724, 6725, 6748, 8417, and 8479.

7293 (AECL–2295) A STUDY OF DILUTION IN THE WINNIPEG RIVER NEAR WNRE. Merritt, W. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Aug. 1965. 8p. Dep.; AECL $0.20.

Rhodamine B, a fluorescent dye, was added to the water in the process sewer at the Whiteshell Nuclear Research Establishment, and its subsequent dilution in the Winnipeg River was measured using a fluorometer mounted in a small boat. The tracer followed the east branch of the river very closely and did not dilute throughout the whole volume of the river until a distance of 13 km was reached. Only small concentrations of tracer were detected in the water supply of Lac du Bonnet, a small village on the west bank of the river 8 km downstream from the sewer outfall. (auth)

7294 (AEET/HP/Environ/4) ENVIRONMENTAL STUDIES IN SOME MONAZITE PLACER AREAS IN SOUTHERN INDIA. PART I. PRELIMINARY SURVEY. Chhabra, A. S.; Kamath, P. R. (Atomic Energy Establishment, Trombay (India). Health Physics Div.). Nov. 1964. 10p. Dep. mn.

Measurements were made on radioactivity of environmental samples from Kayankulam to Cape Comorin in India during Nov. 1963. The samples were monitored for ^{224}Ra, ^{226}Ra, ^{228}Ra, ^{232}Th, and natural uranium by standard analytical methods. The data indicate the trends in uptake and dispersion of daughter products activity in soils, vegetation, food stuffs, and water. (P.C.H.)

7295 (AERE-R–3880) FILTRATION OF HARWELL EFFLUENT. Clarke, J. H.; Parsons, C. P.; Wright, T. D. (Atomic Energy Research Establishment, Harwell (England)). Nov. 1961. 26p. Dep. mn.

A two-stage system for the filtration of Harwell effluent was studied on a pilot plant scale. Experiments showed that the waste arisings can be as low as 0.8% of the throughput for effluent containing 3,000 ppM suspended solids and less than 0.1% of the throughput at 50 to 80 ppM. (auth)

7296 (BNL–9698) MEDICAL SURVEY OF THE PEOPLE OF RONGELAP ISLAND, ELEVEN YEARS AFTER EXPOSURE TO FALLOUT RADIATION (MARCH, 1965). Conard, Robert A.; Meyer, Leo M.; Sutow, Wataru W.; (and others) (Brookhaven National Lab., Upton, N. Y.). 1965. Contract AT(30-2)-Gen-16. 35p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A summary of the major findings of the medical survey of the peoples of Rongelap Atoll carried out in March 1965, 11 years after exposure to fallout radiation, and a thyroid survey carried out in Sept. 1965 are reported. The survey revealed that the general health and nutrition of the Rongelap people had been satisfactory, and that only minor epidemics of influenza and diarrhea had occurred. Physical abnormalities are tabulated for both adults and children. Residual beta burns had changed little in appearance in the past few years, except for a slight increase in pigmented nevi in some cases in the burned areas. Hematological studies showed that for the first time since exposure the average white cell and platelet levels were about the same in the exposed as in the unexposed groups. Definite nodules of the thyroid were noted in several people. The high incidence of thyroid pathology in the Marshallese emphasizes the caution with which radiation must be used clinically, particularly in regard to the use of radioiodines in children. (P.C.H.)

7297 (BNWL–165) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD, JANUARY–JUNE 1965. Wilson, R. H. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1965. Contract AT(45-1)-1830. 29p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Surveillance of the Hanford environs during the first half of 1965 showed that the amounts of radioactive materials present during this period were well within the nationally accepted limits at all times and that releases of radioactive materials from the Hanford plant were adequately controlled. ^{32}P released with Hanford effluent in the Columbia River continued to be the radioisotope that contributed the most exposure to individuals who ate locally caught fish in quantity. (auth)

7298 (CEX–59.7B(Pt.3)) EXPERIMENTAL RADIATION MEASUREMENTS IN CONVENTIONAL STRUCTURES. PART III. THE ATTENUATION OF AIR-SCATTERED RADIATION IN A BASEMENT. Burson, Z. G. (Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.). Apr. 1965. Contract AT(29-1)-1183. 78p. Dep. mn; CFSTI $1.00 cy, $0.75 mn.

An experimental study was conducted to determine the air-scattered radiation contribution to a basement structure from a simulated plane source of ^{60}Co on the ground outside and to determine its attenuation through various structural components. A sealed radioactive source was used to simulate both an area and a ring source. Exposure measurements were made with ionization chamber detectors. A bare, open basement was used as the basic structure. Radiation measurements were made in the open basement; within shelter walls constructed in one end of the basement; within these shelter walls surrounded by sandbags; in the fully constructed shelter with no sandbags; in both the basement and shelter after a wood roof was constructed over the entire basement; in the basement and shelter after a 4-in. layer of concrete planks was placed over the wood roof; and in the basement and shelter after an 8-in. layer of concrete planks was placed over the wood roof. The top of the materials (basement walls, wood roof, or concrete planks) was flush with ground level. This assured that radiation reaching the detectors had been scattered at least once in the air. Comparisons were made with data taken in a similar basement below a two-story brick house. (auth)

7299 (EGCR–4(Suppl.1)) RADIOLOGICAL HEALTH MANUAL FOR THE EXPERIMENTAL GAS-COOLED REACTOR. RADIATION PROTECTION STANDARDS AND REGULATIONS. (Tennessee Valley Authority, Oak Ridge, Tenn.). 1965. Contract AT(40-1)-2742. 28p. Dep.; CFSTI $1.00 cy, $0.50 mn.

Health physics aspects for radiation protection in association with the EGCR are presented. Regulations and standards are listed. (P.C.H.)

7300 (EUR–2579.f) METHODES UTILISEES POUR LA RECEPTION ET L'EVALUATION DU TAUX DE FUITE DES ENCEINTES ALPHA. (Methods Used for Registering and Evaluating the Escape Rate of Alpha Canyons). Gandolfo, J. M. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Sept. 13, 1965. 22p. Dep. mn.

The design and construction of alpha containment boxes is discussed. A general review of method for leak testing closed containment boxes is given. As a result, a method for estimating the leak rate of α-boxes is described. (P.C.H.)

7301 (LA-3382) ^{90}Sr, ^{137}Cs, AND RADIOACTIVE RARE EARTHS IN ENVIRONMENTAL RAIN AND AIR AT LOS ALAMOS, NEW MEXICO, 1963-1964. Graham, Ellis R. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Sept. 1, 1965. Contract W-7405-eng-36. 16p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Strontium-90, cesium-137, and radioactive rare earths were determined in environmental rain and air at Los Alamos, New Mexico. The results showed the activity of strontium-90 to be highest during the summer months. The activity then decreased slowly reaching the lowest level during December and January. The environmental concentrations of cesium-137 and rare earth radioactivity were similar to those for strontium-90. The results of the activity measured in the air and rain followed the same monthly distribution. It was indicated that the rain-held activity is just a wash out of the activity present in the Los Alamos air. (auth)

7302 (NP-15632) TRITIUM HAZARDS ASSOCIATED WITH NEUTRON GENERATORS. Technical Bulletin No. 105. Carver, Kay B. (Kaman Nuclear, Colorado Springs, Colo.). Nov. 1964, Rev. 2. 7p.

A potential tritium hazard exists in high output neutron generators using a deuterium-tritium reaction. Target replenishing and strategically placed isolation valves, as provided in Kaman Nuclear's drift tube neutron generator series A-900 and A-1000, were found to greatly reduce the requirement for opening the system. Therefore, the tritium hazard is significantly lessened. (auth)

7303 (NP-15641) DATA FROM RADIATION PROTECTION PROGRAMS. VOLUME 3, NUMBER 4. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). Apr. 1965. 29p. Dep. mn.

Three articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 7304-7306.

7304 (NP-15641, pp 3-8) ^{90}Sr IN CANADIAN WHEAT FROM THE 1963 CROP YEAR. Samuels, E. R. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of measurements made on Canadian hard red spring wheat grown and harvested during 1963 are reported. The results showed significant variations in the ^{90}Sr levels of wheat grown in different geographical areas. The lowest levels were found in Manitoba and the highest levels in Central Alberta. The average concentration of ^{90}Sr in Canadian wheat grown during 1963 increased by a factor of about 3 over that observed in 1962. It was also established that ^{90}Sr enters the wheat grain either through root uptake from the soil or through direct deposition of fallout on the foliar surfaces. (P.C.H.)

7305 (NP-15641, pp 9-21) CANADIAN FALLOUT DATA FOR MARCH 1965. Samuels, E. R.; Mohindra, V. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of fallout monitoring on air, precipitation, and milk in March, 1965, are reported. The results showed a general but slight, decrease in fallout levels for most aspects of the monitoring program. Data are tabulated. (P.C.H.)

7306 (NP-15641, pp 22-9) REACTOR ENVIRONMENT MONITORING FOR MARCH 1965. Samuels, E. R.; Mohindra, V. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of monitoring studies on surface waters near the sites of the Chalk River reactors, Nuclear Power Demonstration (NPD) reactor near Rolphton, and the Douglas Point (Candu) reactor are reported. Samples of rabbits and fish were also monitored. The radioisotopes determined were ^{89}Sr, ^{90}Sr, and ^{137}Cs. (P.C.H.)

7307 (NP-15642) DATA FROM RADIATION PROTECTION PROGRAMS. VOLUME 3, NUMBER 9. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). Sept. 1965. 45p. Dep. mn.

Four articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 7308-7311.

7308 (NP-15642, pp 3-12) FALLOUT ^{137}Cs BODY BURDENS OF 63 ADULT RESIDENTS OF OTTAWA. Finn, R. J.; Lecuyer, D. W.; Dancey, M. E. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

Whole-body counts were made on adult residents of Ottawa (18 years of age and older), of whom 44 were men and 19 women. It was found that in all cases the only isotopes present were ^{137}Cs and ^{40}K. The results showed that the average ^{137}Cs body burden for the men (26 nC) was greater than for the women (14 nC) as was $^{137}Cs/K$ (183 to 138 pC/g K). (P.C.H.)

7309 (NP-15642, pp 13-19) THE RPD NEUTRON DOSIMETRY SERVICE. Ghosh, S. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

Essential features of the new neutron dosimetry service of the Radiation Protection Division and the characteristics of the dosimeter used are described. Commonly used neutron sources and the various systems for neutron dosimetry are also included. (P.C.H.)

7310 (NP-15642, pp 20-32) CANADIAN FALLOUT DATA FOR AUGUST 1965. Samuels, E. R.; Mohindra, V. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of fallout monitoring of air, precipitation, and milk in Canada during August 1965 are reported. The data show a decrease in radioactivity levels for all parts of the fallout program. However, the level of ^{137}Cs in liquid milk showed very little change during the month. (P.C.H.)

7311 (NP-15642, pp 33-45) REACTOR ENVIRONMENT MONITORING FOR AUGUST 1965. Samuels, E. R.; Mohindra, V. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of monitoring studies near the sites of the Chalk River reactors, the Nuclear Power Demonstration (NPD) reactor near Rolphton, and the Douglas Point (CANDU) reactor are reported. Some whole milk and atmosphere samples were also monitored. All the data are in general agreement with observations made in the fallout program. They do not show any anomalies that could be attributed to a release of contamination from the reactors. Data on total alpha and beta activity, ^{89}Sr, ^{90}Sr, and ^{137}Cs are tabulated. (P.C.H.)

7312 (NP-15678) MONTHLY AVERAGES OF GROSS BETA RADIOACTIVITY IN AIR IN THE WESTERN HEMISPHERE, SEPTEMBER 1961-AUGUST 1965. (Public Health Service, Washington, D. C.). Oct. 20, 1965. 83p.

The monthly averages of gross beta radioactivity for 75 Radiation Surveillance Network stations and 6 Pan American Health Organization stations are presented in both tabular and graphical form for the period Sept. 1961 through August 31, 1965. The sampling procedure used is described. (P.C.H.)

7313 (NYO-2539-4) STRUCTURAL INTEGRITY OF SHIPPING CONTAINERS FOR RADIOACTIVE MATERIALS. PART V. AN ANALYTICAL STUDY OF LONGITUDINAL VEHICLE-COLLISIONS. Doshi, K. D. (Franklin Inst. Research Labs., Philadelphia, Pa.). Nov. 1965. Contract AT(30-1)-2539. 49p. (I-A2412-5). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A basic approach is outlined for developing analytical procedures to predict vehicle collision behavior. The approach is to idealize the physical system by a nonlinear, lumped parameter mathematical model, then to set up the equations of motion of the model and solve these numerically by means of Runge-Kutta propagation techniques for initial value problems. An analysis and digital computer program are provided for numerical evaluation of system response for the longitudinal collision of a tractor semi-trailer carrying a container for

irradiated fuel. The analysis given for this specific case presumes foreknowledge of collision input force and of the force-displacement characteristics of deformable elements of the system; in addition, only longitudinal motion of the system was considered. Modifications can be made to the analysis, if future collision test results indicate these are required. (auth)

7314 (ORNL–3849) HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1965. (Oak Ridge National Lab., Tenn.). Oct. 1965. Contract W-7405-eng-26. 263p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Developmental work is reported in six parts. An abstract was prepared for each part. (J.R.D.)

For abstracts of individual sections see: 6711, 6719, 7315, 7316, 7659, and 8479.

7315 (ORNL–3849, pp 151-82) RADIATION DOSIMETRY. Auxier, J. A. (Oak Ridge National Lab., Tenn.).

Results of continued studies relative to radiation doses in the wartime atomic bombing of Hiroshima and Nagasaki are discussed. Spectrometry and dosimetry research programs are summarized. Efforts devoted to special projects and operations at HPRR are described. (J.R.D.)

7316 (ORNL–3849, pp 215-29) HEALTH PHYSICS TECHNOLOGY. Fish, B. R. (Oak Ridge National Lab., Tenn.).

Results of studies concerning surface contamination and the effects of radioactive iodine on aerosols are presented. Investigations of particle adhesion to solid surfaces and adhesion of particles to skin are described along with studies concerning retention of small particles in the gastrointestinal tract. Design and performance of anthracene dosimeters are discussed. Operation of an in vivo gamma spectrometry facility is described. In vivo measurements of $^{90}Sr-^{90}Y$, and distribution of ^{40}K and ^{137}Cs in calibration mannikins are reported. (J.R.D.)

7317 (ORNL-NSIC–12) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-3. (Oak Ridge National Lab., Tenn.). Nov. 1965. Contract W-7405-eng-26. 121p. ORNL Free.

Approximately 650 references within the scope of the Nuclear Safety Information Center are given to reports and journals published from 1963 through June 1965. Author and subject indexes are included. (P.C.H.)

7318 (PNE–238F) INTERCEPTION AND RETENTION OF RADIOACTIVE FALLOUT BY DESERT SHRUBS IN THE SEDAN FALLOUT FIELD. Project 62.83 [of] Project SEDAN. Martin, William E. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). Dec. 10, 1965. Contract AT(04-1)-Gen-12. 44p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Concentrations of ^{131}I and ^{89}Sr on plants contaminated by fallout from Project Sedan tended to decrease with increasing distance from ground zero and increasing time after the detonation. Microscopic and radiometric examinations of foliage indicated that most of the activity deposited on leaves was probably due to particles $< 5\ \mu$ in diameter. A comparison between the theoretical and observed interrelations of gamma dose rates, ^{131}I and ^{89}Sr deposition rates, and ^{131}I and ^{89}Sr interception by desert shrubs indicated a deficiency of ^{131}I relative to ^{89}Sr in areas more than 40 miles from ground zero and an excess of both ^{131}I and ^{89}Sr relative to dose rates in areas about 100 miles from ground zero. Statistical analyses indicated that the frequency distributions of variates representing maximum concentrations of ^{131}I and ^{89}Sr on plants, and in the tissues of rabbits collected at the same times and locations in the fallout field, were not normal but lognormal. Similar analyses indicated that the frequency distributions of effective half life estimates could be treated as either normal or lognormal. (P.C.H.)

7319 (PNE–480) FALLOUT RADIONUCLIDES IN THE BIOTA OF THE CAPE THOMPSON REGION, ALASKA—A LISTING OF MEASUREMENTS. Watson, D. G.; Hanson, W. C.; Davis, J. J.; Rickard, W. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [nd]. Contract AT(30-2)-Gen-16. 35p. ORAU.

Radioactivity measurements in individual biological samples collected in the biota of the Cape Thompson Region, Alaska, from 1959 through 1962 are tabulated. The radioisotopes measured included: ^{144}Ce, ^{144}Pr, ^{141}Ce, ^{137}Cs, ^{103}Ru, ^{106}Ru, ^{106}Rh, ^{95}Zr, ^{95}Nb, ^{65}Zn, ^{54}Mn, and ^{90}Sr. (P.C.H.)

7320 (RISO–108) ENVIRONMENTAL RADIOACTIVITY IN THE FAROES IN 1964. Aarkrog, A.; Lippert, J. (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). July 1965. 24p. Dep. mn.

Fallout measurements in the Faroes in 1964 are reported. Strontium-90 (and Cs-137 in most instances) were determined in regularly collected samples of precipitation, grass, milk, potatoes, sheep, fish, and drinking water. In addition, analyses of spot samples of soil, sea water, sea plants, birds, vegetables, bread, human bone, and cow's milk were carried out. Estimates of the mean contents of ^{90}Sr and ^{137}Cs in the human diet in the Faroes in 1964 are also given. (auth)

7321 (RISO–109) ENVIRONMENTAL RADIOACTIVITY IN GREENLAND IN 1964. Aarkrog, A.; Lippert, J. (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). July 1965. 26p. Dep. mn.

Results on fallout measurements in Greenland in 1964 are reported. Strontium-90 (and ^{137}Cs in most instances) was determined in samples of precipitation, soil, sea water, vegetation, animals, and drinking water. Estimates of the mean content of ^{90}Sr and ^{137}Cs in the human diet in Greenland are also given. Data are tabulated. (auth)

7322 (SC-DC–65-1790) HEALTH HAZARDS FROM SELENIUM RECTIFIERS. Grillo, John P. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1965. Contract AT(29-1)-789. 13p. (CONF-651037–1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From American Industrial Hygiene Assn., Rocky Mountain Section, Albuquerque, N. Mex.

Hazards from selenium fume as a result of rectifier arc-over are discussed and data and specific examples are included. Methods for determining the amount of selenium exposure in the event of accidents are suggested. (P.C.H.)

7323 (USNRDL-TR–913) A LABORATORY APPARATUS FOR MEASURING THE AMOUNT OF TRITIUM ACTIVITY REMOVED FROM A CONTAMINATED SURFACE, BY DIRECT CONTACT WITH THE SURFACE. Balkwell, W. R.; Kubose, D. A. (Naval Radiological Defense Lab., San Francisco, Calif.). Sept. 30, 1965. 27p. CFSTI $2.00 cy, $0.50 mn.

An apparatus is described that can be used to obtain data for evaluation of the health hazard to personnel who directly contact a surface contaminated with tritium. The sampling component is a small glass roller wrapped with a strip of filter paper dampened with ethylene glycol. It is rolled over the contaminated surface to sample the activity. The sampling apparatus has adjustments to vary the surface contact time, the area of surface sampled, and the pressure applied. After a run, the contaminated roller is dropped immediately after contact with the surface into a counting vial containing a scintillant solution, and the activity is assayed. The apparatus is small enough to be operated in a conventional glove box. The precision of the measurements is influenced by the texture of the surface sampled. Precision measured on a smooth optical quartz surface using a nonvolatile tracer, ^{143}Pm, as a contaminate was determined to be ±2%. The precision for tritium sampling from a relatively coarser, nonuniform metal surface was approximately ±25%. The apparatus can be used to study the rate of tritium desorbed from the surface, which allows estimation of the cumulative hazard effect of multiple contacts with the surface during the desorption period. (P.C.H.)

7324 (CEA-tr-R–1850) LES SOURCES NATURELLES DE RAYONNEMENTS EXTERNES. (Natural Sources of Ex-

ternal Radiation). Gusev, N. G. Translated into French from pp 11-15, Chap. I of Les Doses Maximales Admissibles de Rayonnements Ionisants, 1963. 25p. Dep. mn; JCL $2,60 fs, $0.95 mf.

Among the natural sources of external radiations are cosmic and γ rays from radioactive materials in the soil, water, and construction materials. The radiation levels of external radiation sources and the irradiation doses resulting for the principal vulnerable organs were examined in detail. (tr-auth)

7325 THE RPD WHOLE BODY COUNTER FACILITY. Finn, R. J. Can. Nucl. Technol., 4: 44-6(1965).

A whole-body counter facility is described. There are two whole body counters, both of which employ a multi-detector stretcher technique; one using four NaI(Tl) crystals and the other four plastic scintillators. The two whole-body counters are each housed in 8-in.-thick steel rooms. Details of the calibration experiments already performed and the results obtained on residents of Ottawa are discussed. A few measurements made on residents of the Canadian North are included. (auth)

7326 PLANNING A FALLOUT PROTECTION PROGRAM. Weidemier, G. A. (A. T. Kearney and Co., Chicago). Hospital Progr., 45: 178-82(May 1964).

Three major topics are discussed in considering the importance of a fallout protection program: first, a general description of what happens when a nuclear explosion occurs; second, a discussion of the methodology of evaluating the potential fallout protection of any building, and third, consideration of the habitability features needed in a fallout shelter. Two features contribute to the protection found inside a building: first, the shielding quality of the materials of construction of the roof, walls, and floors; second, the distance to the nearest source of radiation. In discussing these features, the terms mass thickness, reduction factor, and protection factor are defined. The effect of fallout material on the roof and on the ground adjacent to the building are considered separately. Because window openings and the effect of other buildings may vary from wall to wall, a reduction factor should be calculated for each wall as well as for the roof. The reduction factors for the roof and walls of any building are calculated with the aid of a table of mass thickness values for various construction materials and graphs which give the relation between mass thickness, area of effective radiation, and reduction factors. The protection factor is the reciprocal of the sum of all reduction factors for the building, and is usually calculated for a specific location in the building. In most cases the core area in a large building, such as a multifloor hospital, would offer considerably more protection than a point near a window on the basement or ground floor. After the fallout protection has been determined, the additional shielding needed to bring the building up to the desired level of protection may be calculated. Fourteen suggestions are made for improving the habitability of shelters. (BBB)

7327 THE ABSORPTION, RETENTION, AND DISTRIBUTION OF ^{90}Sr FROM NATURALLY CONTAMINATED FOOD BY FEMALE RABBITS. Rosenthal, Harold L.; Harbor, Nelson C. (Washington Univ., St. Louis). J. Dent. Res., 44: 935-9(Sept.-Oct. 1965).

Metabolism of low levels of ^{90}Sr was studied in young and old rabbits fed commercial rabbit chow containing natural products contaminated with fallout ^{90}Sr. During the experimental period in 1961 to 1962, three separate samples of rabbit-diet ash averaged 18.4, 19.0, and 18.9% Ca and contained 19.2, 23.8, and 16.5 pC ^{90}Sr/g Ca, respectively. The total-body ^{90}Sr of weanling rabbits 35 days old ranged from 1.9 to 3.2 pC ^{90}Sr/g Ca. Strontium-90 activity of the body tended to increase during a 40-day feeding period when the animals were fed chow containing 23.8 pC ^{90}Sr/g Ca. In the second experiment, when a diet containing 16.5 pC ^{90}Sr/g Ca was fed, the total-body burden decreased during the 40-day period. During this period, the nuclide activity of the feces and urine averaged 29.3 and 8.7 pC ^{90}Sr/g Ca, respectively. Thus, rabbits fed commercial chow contaminated with about 20 pC fallout ^{90}Sr/g Ca absorb 15% of the ingested nuclide and 41% of the dietary calcium. In young female rabbits fed commercial chow for 20 to 40 days, utilization of dietary calcium over that of ^{90}Sr by the total body occurs with a factor of 3.8, a value comparable to the factor of 4.0 found in man and other animals. The deposition of ^{90}Sr in hard tissues is greatest for rapidly growing teeth, but jaw, leg, and vertebral bones incorporate progressively smaller amounts of ^{90}Sr as the rabbits age. The data suggest that rapidly growing teeth represent a useful index for the estimation of total-body burden and Sr/Ca discrimination factors. Continuously growing rodent teeth may be cut off at intervals and analyzed without sacrificing the animal or may be marked to delineate specific growth intervals. (BBB)

7328 ON X-RAY AND GAMMA-RAY FILM DOSIMETRY WITH SPECIAL RELATION TO FILTER ANALYSIS. Kraus, W.; Nietzsch, J.; Sucker, K. H. (Staatliche Zentrale fuer Strahlenschutz, DDR, Berlin. Deutsche Amt fuer Messwesen und Warenpruefung, Berlin). Kernenergie, 8: 569-73(Sept. 1965). (In German).

Some problems in quantum radiation film dosimetry in the energy range from 10 kev to 2 Mev are considered. The assumptions for substituting a more convenient technique for the Dresel method of filter analysis are presented. The radiations used ordinarily in medicine are applied for calibration instead of the homogeneous ones. This reduces operations in routine control. Criteria were found for such films as must be evaluated by the more exact Dresel method. In practical routine control, these cases are very rare. The energy-independent evaluation after the radiation has traversed a Pb-filter 0.7 mm thick is considered and the magnitudes of some errors in film dosimetry are given. (auth)

7329 IONIZING RADIATION: A POTENTIAL LIGHTNING HAZARD? Gillespie, P. J. (Northern Ireland Radiotherapy Centre, Belfast). Nature, 208: 577-8(Nov. 6, 1965).

Possible hazards to buildings containing radiation sources, especially sources used for radiotherapy, from lightning strikes are considered. The air above the facility containing the source could be ionized, and lightning could follow the ionized path and strike the building. No accidents of this sort have been reported. It is suggested that radiation sources used as lightning attractors on buildings are not actually effective. (M.J.T.)

7330 ATMOSPHERIC RADIOACTIVITY AND COMMERCIAL AVIATION. Medvedeff, M. (Air France, Paris). Presse Med., 72: 3243-4(Dec. 12, 1964). (In French).

Natural radioactivity is unimportant for subsonic flights, and such flights must be concerned only with fallout from nuclear explosions; supersonic flights probably do not need to consider radiobiological effects of cosmic radiation, but may need to take account of solar eruptions at the usual cruising altitudes. They also need to consider passage through clouds of radioactive particles from explosions of atomic bombs, from which contamination by mechanical processes is possible. The regulatory methods used by Air France are described; checks on several planes per week which travel through the most susceptible regions by installation of a Geiger counter or radiometer; collection of dust particles adhering to the vehicle during flight; installation of filters in the exchangers of three Boeing 707's; and installation of a detector-register of γ radiation on two Boeing 707's. Comparison of data from Tokyo-Anchorage and Chicago flights indicates a general contamination of the atmosphere plus particular contamination in the vicinity of Novaya Zemlya. Only slight contamination was found in Boeing 707 motors from these flights and negligible levels in the Caravelle. These tests are performed at Orly Airport by various government agencies in supervision. Data are given in the Report of the S.C.P.R.I. (No. 98); the threshold for particular precautions was not exceeded. (BBB)

7331 WATER POLLUTION POTENTIAL OF AIR POLLUATION CONTROL DEVICES. Gartrell, F. E.

(Tennessee Valley Authority, Chattanooga). pp 387-98 of Air Pollution. Volume 2. New York, Academic Press, 1962.

Interrelations between air and stream pollution are examined, and air pollution control facilities with stream pollution control features are considered along with a review of water quality standards. Many waste materials considered as air pollutants of major concern are likewise objectionable for many water uses, when present in even fairly low concentrations. This is particularly true of wastes involving fluorides (from uranium ore processing) and radioactive materials. Examples are cited of fluoride and radioactive wastes from atomic energy installations, and information as to how stream pollution control features have been incorporated in air pollution control facilities is revealed. One example referred to is the Feed Materials Production Center located at Fernald, Ohio, which produces uranium and thorium metal. This plant is located on the Miami River, which provides a means for disposal of liquid wastes. Of the problems of waste disposal at this plant, the biggest is with fluorides. The plant processes result in excess hydrofluoric acid used in the process, hydrofluoric acid generated by the process, and metal fluoride by-products. For air pollution control, off-gases containing HF are scrubbed before discharge to the atmosphere. Insoluble fluorides are removed from scrubber systems by filtration and stored in the ground in a pit on the site prepared specially to prevent ground water contamination. Neutralized soluble fluorides from scrubber systems are discharged with other treated wastes to the river. All liquid wastes are discharged to a central sump from which they are discharged at a controlled rate dependent on concentration of contaminants and river flow. By careful regulation of waste discharge to stream flow, the amount of fluoride discharged is kept well below the permissible level of 1.2 ppM fluoride. Waste disposal practices at Oak Ridge National Laboratory are also described as illustrative of an integrated radioactive waste disposal program involving air pollution and water pollution control. Wastes are disposed of in four ways: by discharge into the atmosphere through tall stacks, by storage and decay, by fixation in the soil of the waste disposal area, and by discharge to the Clinch River. A minimum amount of radioactive material is discharged to the Clinch River and into the atmosphere. Other Atomic Energy Commission Laboratories (Argonne and Los Alamos) are also considered as examples where air-cleaning devices contribute materials to the liquid waste disposal systems. (BBB)

7332 ^{60}Co OXIDE INHALATION. Jordan, R. D.; Burkle, J. S.; Brown, L. T.; Hargus, J. W.; Nichols, J. H. (Naval Hospital, Bethesda, Md.). pp 281-9 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Whole-body counting was used to evaluate the radiation dose from the inhalation of relatively small amounts of ^{60}Co oxide by 3 individuals. Representation of the disappearance curve by three exponentials supports the hypothesis of multiple mechanisms for the clearance of particle matter from the lungs. An examination of the area in which one individual was contaminated revealed a wide distribution of particle sizes, from pieces large enough to pick up to extremely fine dust. These observations were confirmed (in view of the deposition model proposed) by the distribution in the upper and lower respiratory tract as shown by the scans. It is not possible at this time to associate a specific mechanism of removal with a particular half life component with any certainty. It is, however, possible that the 1.5 day half life mechanism is due to ciliary action. The other longer half lives could well be the result of phagocytosis, solubilization, and transport or physical transport through the lung parenchyma. There is also some evidence of translocation to the liver. (C.H.)

7333 RELATIONSHIPS OF RADIOCESIUM AND POTASSIUM IN THE DIET AND BODY OF FINNISH LAPPS. Miettinen, Jorma K.; Roine, Paavo; Liden, Kurt (Univ., Helsinki. Univ. of Lund, Stockholm). pp 511-16 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Results are reported from a survey of the ^{137}Cs and K content in the diet of 180 inhabitants of the county of Inari, Finland, the main living area of Finnish Lapps. One hundred and forty-nine of the persons studied were Lapps. A similar survey was made of inhabitants of Helsinki for comparison. Individual food consumption and its seasonal variations were determined by interview and the persons studied were classified into several groups on the basis of their profession, diet, and traditional tribal groupings of the Lapps. The high consumption of fish and meat, particularly reindeer meat, and the low consumption of milk products, leaf vegetables, and fruits were characteristic of the diet of Lapps. Representative samples of foodstuffs, both locally produced and imported, were analyzed for ^{137}Cs and K, and the content in the monthly diet of the different groups was calculated. Reindeer meat was responsible for 70 to 90% of ^{137}Cs in the diet. Meat, fish, milk, potatoes, and cereals were important sources of K in the diet. The Lapps were found to contain more K/kg of body weight than people in southern Finland. (C.H.)

7334 HIGH ^{137}Cs BODY BURDENS OF LAPPS AND OTHER PEOPLE IN NORTHERN SCANDINAVIA AND THE FOOD CHAINS INVOLVED. Naversten, Yngve; Liden, Kurt (Univ. of Lund, Sweden). pp 517-26 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Data are presented on the ^{137}Cs content in residents of Sweden and Finland in 1961, determined with a whole-body counter. The contribution of reindeer meat in the diet of Lapps to the high ^{137}Cs content in humans is discussed.(C.H.)

7335 STATISTICAL STUDY OF THE DISTRIBUTION OF ^{137}Cs FALLOUT BETWEEN INDIVIDUAL MEMBERS OF A LARGE POPULATION. Ellett, W. H.; Brownell, G. L. (Massachusetts General Hospital, Boston). pp 540-9 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Cesium-137 has a turnover in the body of about 100 days so the adult population is essentially in equilibrium with its radioactive environment. Muscle tissue is the single organ of highest concentration and contains approximately half the body cesium. Results are reported from a statistical study of the distribution of ^{137}Cs fallout between individual members of a large population. Muscle samples were dissected from the thigh or lower abdomen during post mortem operations and the γ spectra of normal and defatted samples were measured. Data from 670 individuals collected from 1959 to 1962 were coded and assembled on magnetic tape for analysis with a 7090 digital computer. Appropriate control cards allowed the samples to be analyzed by sex, age at death, and geographic location of the patient's home. The relation of ^{137}Cs content of man to the content of fallout in foodstuffs was demonstrated. The body burden of ^{137}Cs throughout 1959 was relatively constant, with a decrease in 1960, followed by a slight increase in the fall of 1961. Despite the large variation among individual samples, a downward trend was evident. The statistical methods used for analysis of the data are discussed. (C.H.)

7336 WHOLE BODY COUNTERS AND PUBLIC HEALTH. Gaffney, George W. (Public Health Service, Washington, D. C.). pp 579-83 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Whole-body counters are useful tools from the public health standpoint. Whole-body counters provide the means of making direct and reliable periodic determinations in the same individuals of some of the most important short and long lived radionuclides in living humans in population groups. The technique lends itself to the testing of the validity of estimates of certain burdens of radionuclides based on measurements of levels in the environment. It offers promise in the establishment of a network for the estimation of body and organ burdens of several important nuclides in suitable population samples independent of information on amounts, times, and routes of intake. (C.H.)

INSTRUMENTATION

General

Refer also to abstracts 7045, 7252, and 7576.

7337 (AERE-R-4556) TEMPERATURE MEASUREMENT IN A HIGH-TEMPERATURE X-RAY DIFFRACTOMETER. Baker, T. W.; Baldock, P. J.; Spindler, W. E. (Atomic Energy Research Establishment, Harwell (England)). Oct. 1965. 12p. Dep.

A calibration procedure for the measurement of the diffracting surface temperature to ~2000°C in a high-temperature attachment to a Philips diffractometer is described. This procedure gives an accuracy of ±30°C at 2000°C. The calibration has shown that the diffracting surface can be up to 150°C cooler than the bulk of the specimen. (auth)

7338 (BNWL-148) ELEVATED TEMPERATURE EXTENSOMETER FOR THE REMOTE TENSILE TESTING OF IRRADIATED SPECIMENS. Barker, R. W.; McDaniel, P. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1965. Contract AT(45-1)-1830. 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A standard commercial extensometer was modified to provide direct strain measurements in various elevated-temperature environments with the accuracy of ASTM class B-1 standards and the simplicity of the parent model. The modified extensometer was successfully employed with a remotized Instron machine in conducting several hundred tests of irradiated metals, alloys, and composite structures at temperatures to 500°C. (auth)

7339 (ECOM-2626) A SIMPLE LEVEL INDICATOR FOR LIQUID HELIUM AT ALL TEMPERATURES. Wasilik, R. M.; Neeper, D. A.; Pearce, D. C. (Army Electronics Command, Fort Monmouth, N. J.). Aug. 1965. 10p. CFSTI $1.00 cy, $0.50 mn.

Characteristics of a very simple liquid helium level indicator for all temperatures are described. Levels can be measured with an accuracy of ±1 millimeter using a carbon resistor, battery, and multimeter with a negligible liquid helium loss. (auth)

7340 (INR-629/IA/PL) BUDOWA MODULOWEJ APARATURY ELEKTRONICZNEJ WEDLUG NORM RWPG (ZESTAW ZASILACZY). (Modular Electronic Circuitry; Power Supplies). Kalisz, Jozef (Institute of Nuclear Research, Warsaw (Poland)). May 1965. 21p. Dep.

The main features of modular electronic blocks are described. Some circuits of power supplies and their technical data are given. (auth)

7341 (NASA-CR-54780) ULTRASONIC TEMPERATURE MEASURING DEVICE. Quarterly Progress Report No. 1. Carnevale, E. H.; Lynnworth, L. C.; Klaidman, S. L. (Parametrics, Inc., Waltham, Mass.). Oct. 1965. Contract NAS3-7981. 18p.

Further research is reported on room and elevated temperature preliminary ultrasonic measurements, capsule design, and construction and testing (nonradiation tests only). The analysis and experiments so far reveal no difficulties not originally anticipated. Radiation effects, including transmutations, are expected to be insignificantly small. Ultrasonic transmission tests indicate that "lead-in" wires at least 40 ft. long can be used between the transducer coils and the sensor element. By slightly modifying the transducers and the pulsing unit, 1 in. sensors should be usable over the entire temperature range, together with an expected thermometry accuracy of about 1%. In preparation for the high temperature irradiation experiments, capsules were designed, incorporating both gamma and electric heating. These designs provide a high temperature soak due to gamma heating, plus electric heating to raise temperatures to the maximum levels required. (auth)

7342 (Y-1489) PRINCIPLES AND OPERATION OF THE ALIGNMENT INTERFEROMETER. Baldwin, R. R.; Whitten, L. G. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). July 14, 1965. Contract W-7405-eng-26. 33p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The alignment interferometer was developed as an instrument for measuring deviations from straightness. Measured values are read directly as linear displacement without resorting to trigonometric conversion techniques. Orientation of the instrument is used to readily isolate slide errors due to pitch and yaw. This technique greatly simplifies error analysis and correction. A deviation from a straight line of less than 10 microinches can be detected at a distance of two yards. Calibration is performed with routine procedures and equipment. (auth)

7343 (K-Trans-8) DEVICE FOR THE STABILIZATION OF THE ROTOR MOVEMENTS OF HIGH-SPEED CENTRIFUGES. Steenbeck, Jena; Scheffel, Rudolf; Zippe, Gernot. Translation of German Patent 1,136,644, Oct. 22, 1958. 7p. Dep. mn; JCL $1.10 fs, $0.80 mf.

A device is described for stabilizing the rotor movements of high-speed centrifuges in which the rotor essentially rotates about its free vertical axis after overcoming, at least once, critical speed and where energy is removed from the vibrations occurring in addition to the rotating movement by means of damping agents. (M.O.W.)

7344 A SIMPLE CIRCUIT FOR GENERATING A PULSE GROUP TO TEST OVERSHOOTS IN LINEAR AMPLIFIERS. Greupner, H. (Humboldt-Universitaet, Berlin). Kernenergie, 8: 437-8(July 1965). (In German).

The circuit designed for generating pulsed groups to test overshoots in linear amplifiers is described and its characteristics are given. The pulse path at individual points of the circuit was determined oscillographically and is shown schematically. (J.S.R.)

7345 DOUBLE NEUTRON DIFFRACTOMETER FOR AMES LABORATORY IN U.S.A. Hagihara, Satoru; Miyashita, Kyoichi (Mitsubish Electric Mfg. Co., Ltd., Japan). Mitsubishi Denki Giho, 39: 1076-82(Sept. 1965). (In Japanese).

A double neutron diffractometer is described, which is a combination, a triple axis-in-elastic scattering diffractometer, and a double axis diffractometer. It permits taking out two monochromatic beams independently variable in their wavelength through only one beam hole of reactor. Two individual diffractometers are controlled by means of program-control instruments which operate under the instructions of perforated tapes. The whole equipment including neutron measuring instruments is completely provided with solid-state elements. (auth)

7346 BEHAVIOR OF NETWORKS REALIZED WITH BINARY FREQUENCY DIVIDERS. Bendiscioli, G.; (Univ., Pavia); Antoni, G. Degli. Nuovo Cimento (10), 40B: 39-68(Nov. 11, 1965).

The properties of networks realized with binary frequency dividers (capacitively coupled flip-flops) are investigated. Arbitrary connections among the flip-flops are considered. A simple model of the nets and of the flip-flops is used to develop a simple method of analysis, which follows a step-by-step procedure. It is shown how to determine the state sequence for multi-input networks. It is also shown that the considered nets may be unstable. A synthetic approach is developed to investigate further their nature. It is possible to give the stability criterion for the networks. When a net is stable, there exists at least a periodic part of its state sequence; if more periodic sequences exist, their periods are the same. A method to determine the period is given. A simple synthesis procedure can be developed when the periodic part of the sequence is of interest. It is shown how the state sequence changes when the input connections are modified. Some of the results are discussed and extended to general frequency dividers. (auth)

7347 PRODUCTION OF SHORT FOCAL LENGTH FIELD LENSES FOR X AND UV RAYS AND CORRECTION PLATES FOR ELECTRON MICROSCOPY. v. Grote, K. H.; Moellenstedt, G.; Speidel, R. (Universitaet, Tuebingen, Ger.). Optik, 22: 252-69(Mar. 1965). (In German).

Methods are described for making metallic self-supporting miniature grids of arbitrary shapes by electron-optical demagnification of an original pattern followed by electrolytic processing of the contamination patterns recorded on a glass-slide previously covered with a thin copper or nickel layer. The original is irradiated with 45-kev electrons. Using a field lens, an original pattern up to 3 mm in diameter can be demagnified 10 to 20 times without distortion. At the same time, the focal position and the distortion in the recording plane can be controlled under electron microscopic observation. When, in the recording plane, a glass slide previously covered with a 300-Å thick silver layer is electron-irradiated for 2 min at a vacuum of 10^{-4} to 10^{-5} torr in the presence of organic molecules, the irradiated sites are covered with a contamination layer about 100-Å in thickness. A metallic layer of copper or nickel, about 0.5-μ in thickness, is deposited by electrolytic action in Watts' solution. Because of the insulating action of the contamination, it grows only in the nonirradiated regions of the slide surface. The metal deposit is mechanically stripped from the glass surface, the contaminated regions sticking to it. Using this procedure, fine holes and fine mesh grids down to a grid spacing of 1 μ can be prepared. In the same way, miniature Fresnel zone plates can be made by 10 to 20 times demagnification of original zone plates. Images of grids, using x radiation ($C_{K\alpha}$ line, λ = 45Å) as imaging radiation, are shown which demonstrate the focal length and imaging properties of the zone plates for x rays. The same method has been used to produce zone plates which are intended to be used as electron optical elements in order to increase resolution or contrast in electron micrographs. Experiments with the Siemens Elmiskop I show that such elements can be inserted in the objective back focal plane without being destroyed by the beam. The effect on the image quality was studied. (BBB)

7348 A TRANSISTORIZED LINEAR GATE. Elad, E.; Rozen, S. (Israel Atomic Energy Commission, Tel-Aviv). Nucl. Instrum. Methods, 37: 58-60(Nov. 1965).

An approach to the design of linear gates is described that is based on "active action". The described transistorized gate consists of a feedback amplifier whose loop gain is highly attenuated during the closed state of the gate. The circuit is designed for positive input signals in the range of 0.1 to 5 v and exhibits linearity better than 1%. The feedthrough and minimum pedestal achieved were 20 and 40 mv, respectively. The circuitry uses d-c coupling to permit operation of the gate at high input rates. (auth)

7349 PULSE RATE STABILITY IN A GENERATOR WITH A SECOND EMISSION TUBE. Serov, A. F.; Yudin, L. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Prib. Tekh. Eksp., No. 5, 129-32(Sept.-Oct. 1965). (In Russian).

The results of the experimental investigation of the stability of the pulse rate of generators with a second emission tube 6V1P and 6V2P are reported. Graphs were obtained that made it possible to evaluate the nonstability of the pulse rate of the generators as a function of the feed voltage in the time interval from 20 to 1000 nsec. The possibility of regulating the pulse rate in a wide range with change of the displacement voltage on the control grid of the tube. (tr-auth)

7350 MAGNETIC FIELD STABILIZATION AND SWEEP BY MEANS OF DRIFT-FREE AMPLIFIER. Koroluk, A. P.; Matsakov, L. Ya. (Inst. of Radiophysics and Electronics, Khar'kov). Prib. Tekh. Eksp., No. 5, 217-19 (Sept.-Oct. 1965). (In Russian).

A system that makes it possible to stabilize, with relatively high precision (~10^5), the field of the electromagnet by the use of a supporting voltage is described. Because of the variable dimensions, either the Kholl device voltage or the voltage drop on a standard resistance can be used. The installation is adaptable for scanning of magnetic field constantly according to an assigned law, for example, the hyperbolic law. This requirement arises during the recording of the lines of cyclotron resonance, magnetoacoustic oscillation, etc., i.e., where the oscillation of different magnitudes have the same period in the reverse magnetic field. The stability of the system is sufficient for the recording of narrow resonance lines, for example the lines of nuclear resonance. (tr-auth)

7351 MEASUREMENTS OF STRONG MAGNETIC FIELDS BY MEANS OF NUCLEAR MAGNETIC RESONANCE CONTINUOUS-FLOW TRANSDUCER. Zhernovoi, A. I.; Stakhov, O. V.; Fedorov, N. D. (Inst. of Nuclear Physics, Academy of Sciences, Alma-Ata, USSR). Prib. Tekh. Eksp., No. 5, 220-1(Sept.-Oct. 1965). (In Russian).

The possibility of the application of nuclear magnetic resonance using a continuous transducer of the polarized nuclei of liquids for the measurement of strong constant magnetic fields was shown. The polarization of the nuclei of the liquid occurs in the magnetic field and the resonance is read with the transducer, installed in the field of the supplementary steady magnet. The block diagram of the apparatus and the characteristics of the method of measurement of the strong magnetic field are described. Some results of the measurement are reported. (tr-auth)

7352 AUTOMATIZATION OF NUCLEAR EMULSION DEVELOPMENT. Ryabov, V. D. (Inst. of Nuclear Energy, Moscow). Prib. Tekh. Eksp., No. 5, 230-1(Sept.-Oct. 1965). (In Russian).

An automatic installation, programmed for the processing of nuclear emulsions, is described. (tr-auth)

7353 INVESTIGATION OF THE CONDITIONS FOR OBTAINING QUICKLY-FALLING FIELDS IN INFLECTOR DEVICES. [PART] II. Il'in, O. G.; Shenderovich, A. M. (Inst. of Physics and Tech., Academy of Sciences, Kharkov). Ukr. Fiz. Zh., 10: 985-90(Sept. 1965). (In Ukrainian).

The characteristics of a discordant inflector are compared with those of an inflector accordant with the line by means of additional capacitors. The dependence of the inflector parameters on the duration of the front of the pulse entering into it is considered. (auth)

Radiation Detection

Refer also to abstracts 6694, 6752, 6754, 6920, 6986, 6992, 6993, 7323, 7743, 8061, 8105, 8317, 8333, and 8346.

7354 (AERE-M-1641) SOME MEASUREMENTS OF NEUTRON AND GAMMA RADIATION FROM CRITICAL ASSEMBLIES. Dennis, J. A.; Boot, S. J. (Atomic Energy Research Establishment, Harwell (England)). Oct. 1965. 18p. Dep.; BIS $0.60; HMSO 3s.

Man-phantoms and neutron and gamma dosimeters were exposed to three different critical assemblies. The sodium-24 activity induced in the phantoms was found to depend on orientation and could vary by as much as 40%. The doses derived from dosimeters shielded by the phantom body from the direct radiation were less than those not so shielded. Fast neutron doses were reduced by 90%, intermediate-energy neutron doses by 70%, thermal neutron doses by 60% and gamma doses by 40%. These results were obtained in situations where there was a high degree of radiation scatter. (auth)

7355 (AERE-NP/GEN/26) MAGNETIC RECORDING SYSTEMS FOR NEUTRON TIME-OF-FLIGHT EXPERIMENTS. Hall, J. W. (Atomic Energy Research Establishment, Harwell (England)). Nov. 1964. 34p. Dep. mn.

The use of magnetic tape for various time-of-flight experiments is discussed. A prototype tape recording system providing 400 time channels is described. It is shown that the method is immediately adaptable to a 64,000 channel spectrometer. The method is extended logically, and a very simple and cheap spectrometer

using a magnetic drum is proposed to provide a small number of channels. This system is especially suitable for "chopper" experiments. Appendices deal with the effects of errors introduced by the use of tape and measurements of the number of pulses lost when recording is used. (auth)

7356 (BNL–9722) FILTER—PROGRAM ORGANIZATION. Nardi, J. A. (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT(30-2)-Gen-16. 5p. (CONF-651044–3). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Conference on Programming for Flying Spot Devices, New York.

FILTER is a 99% FORTRAN II three chain link program coded to run under the Brookhaven Operating System. It uses approximately thirty-one thousand core locations of which three thousand are for system routines. The program contains optional sense switch and key-bit controls which allow deviation from the normal flow for purposes of debugging or making special purpose runs, e.g., event types of one kind. During production runs, in order to preclude loss of computer time due to unforeseen difficulties there are various diagnostics to warn of abnormalties while running, e.g., an inconsistency on one of the input tapes. (M.O.W.)

7357 (BNL–9729) 3.4 THREE-VIEW GEOMETRY DIAGNOSTIC. Crennell, D. J. (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT(30-2)-Gen-16. 14p. (CONF-651044–2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Conference on Programming for Flying Spot Devices, New York.

A summary of the last stage in the generation of track points in the BNL FILTER program is presented. The technique involved for reconstructing the bubble chamber tracks is briefly discussed. (M.O.W.)

7358 (EGG–1183-2057) EG AND G/DBM MONTHLY PROGRESS REPORT [ON INSTRUMENTATION AND SHIELDING], OCTOBER 1965. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Contract AT(29-1)-1183. 18p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Experimental studies of the response of NaI detectors viewed with multiple photomultipliers were performed. A detector collimator system was designed and investigated experimentally. The design study of systems for stabilization of NaI scintillation spectrometers was completed. Further research on radiological shielding studies was carried out. Recalibration results for the Phil gamma dosimeter are presented. (M.O.W.)

7359 (EUR–2580.e) LITHIUM DRIFTED SEMICONDUCTOR DETECTORS IN NUCLEAR SPECTROSCOPY. Bertolini, G.; Cappellani, F.; Fumagalli, W.; Henuset, M.; Restelli, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Aug. 31, 1965. 10p. Dep. mn.

Results obtained in beta and gamma spectroscopy, together with short details on the construction of silicon and germanium Li-drifted detectors are presented. (auth)

7360 (IDO–17122) A PRACTICAL SIMULTANEOUS ALPHA-BETA COUNTER FOR APPLIED HEALTH PHYSICS. Smith, K. F.; Sommers, J. F. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Nov. 1965. Contract AT(10-1)-205. 15p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A window-type simultaneous alpha-beta counter for health physics is described. It features stable alpha and beta sensitivity, alpha sensitivity approximately equal to that obtained with alpha counters, beta sensitivity approximately $\frac{1}{3}$ of that obtained with beta counters, and reduced beta background response. (auth)

7361 (INR–594/IA/PL) A FAST MULTIPLE COINCIDENCE CIRCUIT USING AVALANCHE TRANSISTORS. Kalisz, Jozef (Institute of Nuclear Research, Warsaw (Poland)). Jan. 1965. 24p. Dep. mn.

A simple and reliable coincidence circuit using transistors working in the avalanche mode is described. Using the 56 AVP photomultipliers, the NE 102 plastic scintillator and the ^{210}Po α-ray source, the minimum resolving time is 0.7 nanosecond with 80 per cent efficiency and maximum 15 nanoseconds with 100 per cent efficiency. Both the number of coincidence channels and the resolving time of the circuit can be selected independently. (auth)

7362 (INR–638/I/PL) ADAPTACJA 100 KANALOWEGO ANALIZATORA AMPLITUDY TYPU AI-100-1 "RADUGA" DO POMIAROW CZASOWYCH. (The Adaptation of 100-Channel Amplitude Analyser "Raduga" Mod. AI-100-1 for Time Measurement). Lenartowicz, J.; Turos, A. (Institute of Nuclear Research, Warsaw (Poland)). 1965. 12p. Dep.

Investigations of nuclear reactions products with decay periods of 10^{-3} to 10 sec require the use of multichannel time analyzers. The adaptation of the one hundred channel pulse height analyzer "Raduga" for time measurements, without distorting its ability to work as a pulse height analyzer is discussed. The time channel width depends on the external time generator. The minimum time channel width was about 40 μsec and depended on the rate of registration in analyzers memory. (auth)

7363 (INR–652/IA/PL) A METHOD FOR DETERMINATION OF THE RESOLVING TIME AND EFFICIENCY OF THE COINCIDENCE CIRCUIT ON THE BASIS OF A SINGLE EMPIRICAL DELAYED COINCIDENCE CURVE. Kalisz, Jozef (Institute of Nuclear Research, Warsaw (Poland)). Sept. 1965. 47p. Dep.

A mathematical method for determination of the main coincidence circuit parameters (resolving time, jitter breadth, efficiency) only on the basis of a single empirical delayed-coincidence curve is described. The method assumes Gaussian jitter distributions and permits this assumption to be verified. Exact tables and graphs together with two examples illustrating the method are given. (auth)

7364 (JINR–P–2420) POPRAVKI NA GEOMETRICHESKIE ISKAZHENIYA NA SNIMKAKH S ISKROVYKH KAMER. (Corrections for Geometric Distortions in Spark Chamber Photographs). Bystritskii, I.; Lehar, F.; Maly, M.; Sgon, O.; Yanout, E. (Joint Inst. for Nuclear Research, Dubna (USSR). 1965. 18p. Dep. mn.

Geometric distortions appearing when particle tracks are photographed in spark chambers are treated. Formulas are deduced for corrections taking into account the distortion of the picture owing to: non-parallel alignment of the spark chamber wall and plane of the film; and non-alignment of the axes of the spark chamber lenses and those of the camera objectives. The corrections for the optical system used in measurements of elastic p-n scattering are calculated as an example. (auth)

7365 (KFK–342) BERICHT UEBER GASGEFUELLTE SCHWELLEN-CERENKOV-ZAEHLER. (Report on Gas-filled Threshold Cherenkov Counter). Galster, S.; Hartwig, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). July 1965. 14p. Dep. mn.

Cherenkov counters are velocity-sensitive counters for charged high-energy particles. For synchrotron electron scattering experiments on a 6-Bev electron synchrotron, two types of threshold Cherenkov counters (SCZ I and SCZ II) with gas filling of CF_3Cl are constructed to differentiate between the extremely relativistic electrons in a divergent beam of pulsed analyzed electrons, μ mesons, and π mesons. SCZ I is divided optically into 5 equal sections because of its large size. SCZ II is a smaller counter, which optically corresponds to one section of the SCZ I. (tr-auth)

7366 (LA-DC–7323A) DETERMINATION OF THE NEUTRON CONTRIBUTION TO THE REM DOSE. Hankins, Dale E. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 12p. (CONF-651109–14). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 1st Symposium on Accelerator Radiation Dosimetry and Experience, Upton, N. Y.

A description is given of the single-sphere neutron-

monitoring instrument and its neutron-energy response. Three years of operating experience with several models of these instruments are described. The limitations for use of the instrument for accelerator-produced neutrons and some of the special applications of the instrument are discussed. (auth)

7367 (NASA-TN-D-3108) AN INVESTIGATION OF THE INTENSITIES AND CHARGE COMPOSITION OF LOW ENERGY ELECTRONS AT BALLOON ALTITUDES [Thesis]. Serlemitsos, Peter (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Dec. 1965. 23p. CFSTI $1.00 cy, $0.50 mn.

Submitted to Maryland Univ., College Park.

A detector was designed and constructed for the purpose of measuring the positron-to-electron ratio at balloon altitudes as a function of electron energy, in the range from about 1 to 15 Mev. The principle of operation as well as problems encountered in design, construction and calibration are discussed. In addition, data from a recent flight over Northern Canada are presented and their implications with regard to the detector's purpose are considered. Possible ways for improving the present apparatus are mentioned along with the apparent limitations of this type of detector when used to conduct cosmic ray research at balloon altitudes. (auth)

7368 (NYO-3421-5) PHOTOMULTIPLIER INVESTIGATION. Quarterly Report No. 4, August 15–November 14, 1965. Smith, H. M. Jr.; Wasserman, R. (RCA Labs., Radio Corp. of America, Princeton, N. J.). Dec. 1, 1965. Contract AT(30-1)-3421. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Two problems often encountered by users of photomultiplier tubes today are those of dark pulses and gain shift with count rate or short term stability. Recent investigations on the causes of these problems are presented. With regard to the dark current problem, further studies of the oxidation process indicate that substantial reduction of the count rate of the larger type B pulses can be obtained without seriously impairing cathode efficiency. It was also found that light is emitted from a photomultiplier for many (if not most) of the type B pulses. Further study of stability was delayed until background problems which mask the effects being sought can be eliminated. (auth)

7369 (SGAE-SS-2/1965) ERMITTLUNG DER ERFASSUNGSGRENZE BEI MESSUNGEN RADIOAKTIVER STOFFE. (Determination of the Detection Limit in the Measurement of Radioactive Materials). Kambourov, Christo (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). 1965. 18p. Dep.

An accurate formula for the calculation of the lowest possible detection limit at optimum measurement conditions was derived. A method for rapid determination of the minimum measurement time (blank value and total effect) is given. A value of 95% was assumed for the practical liability limit. Some quantitative problems were solved in order to make the formulas intelligible. The formula derived for the calculation of the lowest possible detection limit made it possible to determine the most sensitive instruments. (tr-auth)

7370 (TID-22395) REPORT ON STUDY FOR HIGH INTENSITY RADIATION SURVEY PROBE. (Texas Nuclear Corp., Austin). Sept. 27, 1965. Contract AT(11-1)-Gen-14. 32p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A High Intensity Radiation Survey Probe was designed based on a two-crystal coincidence Compton recoil spectrometer. The spectrometer weighs approximately 44 pounds and is capable of operation in fields as high as 65 R/hr. An increase in peak to Compton ratios by an order of magnitude in this spectrometer provides signal to background ratios of 3:1 for a 250 mR/hr ^{60}Co source and 1.8:1 for a 4R/hr ^{60}Co source. Ratios of 10:1 and 3:1 are obtained for comparable ^{137}Cs radiation fields. The efficiency is the order of 10^{-3} and the resolution is approximately 15% for ^{137}Cs. Improved crystals may well increase the resolution and signal to background ratio. (auth)

7371 (BNL-tr-17) SPARK CHAMBERS IN A MAGNETIC FIELD. Dayon, M. I.; Knyazev, V. M.; Marikyan, G. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated by Stephen Amoretty (Brookhaven National Lab., Upton, N. Y.). 11p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf.

Experimental data are presented for the amount of spark mixing in the magnetic field ($E \times H$ effect) of the chambers containing a mixture of air, argon, and alcohol vapors for a wide range of values of the magnetic field, the clearing electric field, and for the high voltage impulse delays. The calculation and nature of the $E \times H$ effect in similar chambers and in chambers containing inert gases is given. The spark chambers are described and their counting and time characteristics are discussed. (M.O.W.)

7372 A SPECTROMETRIC METHOD FOR SIMULTANEOUS ASYMMETRY MEASUREMENTS IN FAST-NEUTRON POLARIZATION EXPERIMENTS. Molea, M.; Calboreanu, A.; Minzatu, I. (Inst. of Atomic Physics, Bucharest). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 475-84(1965). (In Rumanian).

The currently used time-of-flight method for measuring the polarization of fast neutrons generated in nuclear reactions requires consecutive recording of the spectra of neutrons, scattered elastically at angles of $+\theta$ and $-\theta$. The method was improved by recording the spectra at $+\theta$ and $-\theta$ simultaneously without changing the beam and the conditions of geometry and using only one time-amplitude converter. The two detectors and the slow discrimination paths used must be identical and the dead time of the system must not cause a deformation of the spectra. The amount of recorded information must also be kept constant. The fulfillment of these requirements was experimentally verified. In order to check the spectra, the signal of one of the detectors was delayed to avoid superimposition of the γ and neutron peaks. (TTT)

7373 RADIATION DETECTORS WITH SEMICONDUCTOR DEVICES. PART II. CHARACTERISTICS OF SEMICONDUCTOR DETECTORS. Poenaru, D.; Vilcov, N. Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 695-723 (1965). (In Rumanian).

Operation of semiconductor detectors depends on electric parameters, such as the volt-ampere characteristics, the capacity of the barrier layer and the thickness of the space charge region. Knowledge of these parameters makes it possible to determine the width of the profile of the detector, establishing the maximum energy, at which linearity of the spectrometric measurements can still be maintained. A nomogram was developed for facilitating calculation of the space charge region for a given resistivity of the semiconducting material and a given voltage. The detection characteristics include the maximum energy that can be linearly detected as a function of the applied voltage, the efficiency, energy resolution, and time-related properties. The energy resolution can be conveniently measured by means of a ^{241}Am source which possesses three suitable lines at 5.477, 5.435, and 5.375 Mev. A fast time response is especially important for time-of-flight measurements, multiple coincidences, detection of charged particles in the presence of a strong γ background, and rapid collection of data from a pulsed accelerator. The effect of temperature, of magnetic field, and of light on the sensitivity of the detector was also examined, together with the effect of γ and neutron radiations. (Review article). (TTT)

7374 RADIATION ABSORPTION AND CHARGE SEPARATION IN SEMICONDUCTOR COUNTERS. de Vries, H. (Universitaet, Marburg, Ger.). Ann. Phys., 16: 41-69 (1965). (In German).

The spatial expansion of the trace of increased electron-vacancy pair concentrations, which occur in the absorption of heavy charged particles in a crystal counter, and the time pattern of their origin, can be determined through the discussion of the various slowing-down processes. The electric properties of the particle track and the process of charge separation were investigated. The representation by Brown on successive plasma decomposition through the electric field was extended to include the electrostatic

effect in the particle track. A quantitative comparison was carried out between the charge separation through the electric field and the charge separation through the "normal" diffusion processes assumed by Northrop and Simpson. In the treatment of charge separation it is proved that the diffusion process in a particle track can be described by a differential equation of the second order. According to the solution of this equation the time pattern of the diffusion process goes through two successive stages. The first rapid stage of the diffusion process can be described with the process of a particle slowing down to a common process in which a range of increased electron–vacancy pair concentration is given as a particle trace. This length expansion is given by the range of the projected particles whose diameter was determined from the semiconductor properties (diffusion constant and collision time) of the crystal. Discrepancies between these and previous results are discussed. (L.B.S.)

7375 SOLID-STATE TRACK DETECTORS: APPLICATIONS TO NUCLEAR SCIENCE AND GEOPHYSICS. Fleischer, R. L.; Price, P. B.; Walker, R. M. (General Electric Co., Schenectady, N. Y.). Ann. Rev. Nucl. Sci., 15: 1-28(1965).

Experimental techniques for using solid-state track detectors are presented, followed by a description of those applications to nuclear science that have already been demonstrated or appear promising. The techniques for revealing tracks are described, and the various characteristics of solid-state track detectors are summarized, such as their sensitivities and the effects of temperature, pressure, and ionizing radiations or track stability. The theory of track formation is treated, and applications of solid-state track detectors to nuclear physics, radiation dosimetry, and activation analysis are dealt with. A discussion of fossil tracks in terrestrial and extraterrestrial minerals is included. (L.B.S.)

7376 IDENTIFICATION OF β-ACTIVITIES IN A LOW-LEVEL-EQUIPMENT. Fleck, C. M. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 10: 462-5(Nov.-Dec. 1965). (In German).

A method is described for the identification of β-active gases having a concentration of 10^{-16} C/cm^3 in a low-level-equipment. Two coaxial annular proportional counters are used to measure the pulse-height spectra of β-particles, which are coincident in both annular tubes. Therefore the transmission of β-particles having the most probable energy can be measured almost simultaneously for several β-activities. By means of a calibration curve it is possible to determine the decay energy with an error of ±10%. Discrimination of both coincidence channels lowers the background so much that one can measure β-activities with energies, between 0.2 and 10 Mev down to a concentration below 10^{-16} C/cm^3. For example ^{41}Ar, ^{85}Kr, and RaB are determined in air, and their concentration measured. (auth)

7377 A DIGITAL COUNTINGRATEMETER WITH LINEAR DISPLAY. Wuttke, W.; Stanek, F. W. (Technische Hochschule, Munich). Atomkernenergie, 10: 466-70(Nov.-Dec. 1965). (In German).

A digital count-rate meter is described that consists of an electronic counter and a flip-flop-memory. By means of clock pulses with constant spacing the stored number of pulses in the memory is corrected to the number of pulses being collected in the counter during the last clock interval. The state of the memory is shown by display lamps in the binary code and by a voltmeter. The voltage for this meter is produced by a resistor network, proportional to the count rate. The rate at full scale can be changed by the variation of the clock frequency. The advantage of this sort of rate meter, being more expensive than a RC integrator, is the fact, that there is no loss of information for count rates being out of scale. In this case an overflow occurs in the memory. The displayed count rate is now the real count rate minus the memory volume for one overflow, or minus several memory volumes for several overflows. This rate meter is also a very efficient tool for displaying little instabilities in high rate, by allowing several overflows during one clock interval. In this case the display happens with suppression of the zero-point in the count-rate scale. The use for this device in health physics, for survey measurements and for reactor control is noted. (auth)

7378 COMPARISON OF ELECTRON-DEPTH-DOSE DISTRIBUTIONS MEASURED WITH AN IONIZATION CHAMBER AND BY MEANS OF THE CHANGE IN OPTICAL DENSITY. Aiginger, H.; Hubeny, H. (Oesterreichischen Hochschule, Vienna). Atomkernenergie, 10: 479-83(Nov.-Dec. 1965). (In German).

The depth-dose distribution of 0.5, 1.0, and 2.0 Mev electrons in aluminum and cellulose diacetate was measured with an air-filled parallel-plate ionization chamber with variable electrode spacing. These measurements were compared with depth-dose measurements, which used the change in optical density of 50 μm thick cellulose diacetate foils at 320 nm wavelength. It was found that the accuracy of the second method in determining the depth-dose distribution is practically equal to that of the well established ionization chamber method. The maximum deviations of both methods in the useful range are about 10% of the value at a certain depth. The proportionality of the change in optical density and the dose was tested for dose rates from 1 to 8 Mrad/s and for energies from 0.5 to 2 Mev. No influence of the dose rate or the energy could be found. (auth)

7379 STATISTICAL STUDY OF THE DISTRIBUTION OF TRANSPARENCE DEVIATIONS DUE TO GRANULARITY. Berwart, L. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 34: 266-83(1965). (In French).

In determining the distribution function of transparency deviations, a negative emulsion of high sensitivity was used as a photographic emulsion. Several regions of different density were examined with circular spots of different diameter. The results obtained made it possible to calculate the probability that a transparency variation is due to the granular background of the image or to the signal superposed on this granular background and to determine the probability of detecting a signal superposed on the background. (J.S.R.)

7380 BACKGROUND SPECTRUM OF PHOTOGRAPHIC EMULSIONS. Berwart, L. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 34: 284-301(1965). (In French).

A statistical determination of the background spectrum was made by exploring around a series of points of the picture. In this fashion the importance of the fluctuations around the mean spectra could be shown and the mean dispersion of these fluctuations could be calculated. The experimental curves of the background spectrum were compared with curves calculated for an ideal emulsion, that is an emulsion formed of circular grains having the same radius and dispersed in a completely random manner of the plate. In order to make this calculation, the general relation existing between the theoretical background spectrum and the background spectrum measured on the circumference of the plate with an area spot was made explicit. (J.S.R.)

7381 CHARACTERISTICS OF TWO-FLAME IONIZATION DETECTOR AND AN EXAMPLE OF ITS APPLICATION IN RADIATION CHEMISTRY. Kroh, Jerzy; Bogus, Wlodzimierz; Mayer, Jozef (Politechnika, Lodz, Poland). Chem. Anal. (Warsaw), 10: 635-40(1965). (In Polish).

A two-flame ionization detector was designed. The dependence of the detector signal on the changes of flow rate of gases feeding the apparatus, and on the distance between electrodes was examined by using methane as a standard. Determinations were carried out by the method of introducing constant volume of methane, diluted with nitrogen, into the gas stream entering the detector. The increase of the nitrogen flow rate at constant flow rate of hydrogen caused a nonlinear increase of the value of the detector signal. Maximum detector signal was obtained at the V_{N_2}/V_{H_2} ratio in limits from 1.0 to 1.2. It was found that the detector signal does not change in the range from 10 to 15 mm distance between electrodes. The detector was applied in determination of methane, formed during ethanol radiolysis. (auth)

7382 SPECTROMETER STABILIZED WITH FOREIGN NUCLEI FOR HIGH RESOLVING MAGNETIC NUCLEAR

RESONANCE. Pettig, M. (Friedrich-Schiller-Univ., Jena, Ger.). Exp. Tech. Phys., 13: 270-7(1965). (In German).

In the foreign-nuclei stabilization of a nuclear resonance spectrometer, the nuclei producing the standard lines used for calibration are of a different type than those from which the measurement spectrum is taken. This type of stabilization has a special advantage when the reference line and the measurement spectrum originate from the same sample (single sample spectrometer). Two experimental devices are described that use this measurement principle for side-band oscillator spectrometers. The circuits were laid out so that the modulation frequency given by the side-band oscillator remains constant, which gives an additional advantage for an error-free spectral plotting. (tr-auth)

7383 APPARATUS FOR RADIATION RESEARCH IN SPACE. Cail, R. A. (McMichael Ltd., Slough, Eng.). G.E.C.J. Sci. Tech., 32: 98-106(1965).

Four E.S.R.O. II satellite experiments are described, which were designed to study the lifetimes and production of particles trapped in Van Allen belts; for the measurement of 1- to 100-Mev protons within the inner Van Allen belt and at high altitudes above the earth's atmosphere following solar flares; to study the proton and alpha-particle components of cosmic radiation and the intensity variation as a function of magnetic rigidity; and to measure the flux and energy distribution of primary cosmic electrons in the Bev range. The general arrangement of the satellite is illustrated, which shows the experimental apparatus for the four experiments. Descriptions are given of the apparatus, which includes a primary-electron detector, solar proton telescope, proton-alpha telescope, trapped radiation monitor and data store. Some general observations of the satellite-borne project are made. (L.B.S.)

7384 AN OBSERVATION ON A NEW TYPE OF DISTORTION IN NUCLEAR EMULSIONS. Aditya, Prem K. (Indian Inst. of Tech., New Delhi). Indian J. Phys., 39: 253-6(June 1965).

An event demonstrating the correlation between spurious scattering and the distortion peculiar to pellicles is described. It is shown that the origin of distortion is non-planarity of the pellicle rather than differential shear as generally understood. (auth)

7385 METHOD FOR REVEALING A CLEAR WELL LOCALIZED PARTICLE TRACKS IN A STREAMER CHAMBER. Rudenko, N. S. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zavendenii, Fiz., No. 4, 178-9(1965). (In Russian).

The isotropic streamer chamber, an improvement of the spark chamber, presents the disadvantage that particle tracks are difficult to record. Application of an oscillating potential after the action of the basic pulse increased the ionization within the streamers, creating clearer tracks in the chamber. Calculations indicated that there is an optimum for the oscillations to improve the visibility of the tracks, without increasing the length of the streamers. The calculations were experimentally verified, using 3 neon-filled glass spark chambers. A generator was used to apply a 400-kv, 1.5-nsec. long pulses on the chambers; nitrogen-filled discharge units were connected in parallel. It was found that the tracks obtained while the potential was applied were much clearer than those taken without oscillation; in the latter case the tracks could not be photographed. Even though the experimental conditions were not advantageous, the tracks were better than those obtained by other workers. (TTT)

7386 ROCKET MEASUREMENTS OF ENERGETIC PARTICLES. 1. DESCRIPTION OF THE EXPERIMENT. Mozer, F. S.; Crifo, J. J.; Blamont, J. E. (Service d'Aeronomie, Verrieres-Le-Buisson, France). J. Geophys. Res., 70: 5699-5707(Dec. 1, 1965).

Two rockets were fired along the magnetic field line L = 5.6 to altitudes above 400 km to measure the fluxes, energy spectrums, and angular distributions of protons and electrons with energies above 150 kev. The objectives of the experiment are stated and the payload operation is described. (auth)

7387 INFLUENCE OF SPECIFIC IONIZATION OF THE INCIDENT PARTICLE ON THE MEAN PULSE HEIGHT GENERATED BY GEIGER-MUELLER COUNTERS IN THE CASE OF WEAK OVERVOLTAGES. Bogui, Vincent (Faculte des Sciences, Toulouse). J. Phys. (Paris), 26: 181A-2A(July 1965). (In French).

When the ionic charge (q) generated in the discharges is less than the electrostatic charge (Q_0) on the counter wire $m = q/Q_0 < 1$, the mean pulse height slightly increases as the specific ionization of the incident particle rises. Measurements of the pulse height carried out by a 400 channel analyzer were made with internal cathode end-window and glass-walled externally graphited counters irradiated with α, β, and γ particles. When m is greater than one, specific ionization does not play any part. (auth)

7388 AUTOMATION OF PHYSICAL EXPERIEMENTS WITH POLARIZED NEUTRONS. Chalupa, Bohumil; Kajfosz, Josef; Vavra, Jaroslav; Holeck, Josef (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 11: 330-5(Sept. 1965). (In Czech).

A device is described that makes the apparatus for the measurement of circular polarization of gamma radiation from radiative capture of polarized neutrons on nuclei entirely automatic. Particular attention is aimed at problems having more general importance in the automation of physical experiments. (auth)

7389 SEMICONDUCTING DETECTORS AND THEIR APPLICATIONS. Jungclaussen, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger. Institut fuer Kernforschung, Dubna, USSR.). Kernenergie, 8: 514-41(Sept. 1965). (In German).

The functions and types of semiconductor detectors and their physical basis are discussed. Charge carrier collection, energy resolution, amplification, noise, time dependence, and radiation damage in the detector-amplifier system are considered. Applications of these detectors are discussed. (157 references) (M.C.G.)

7390 INTEGRATING DOSIMETRY OF IONIZING RADIATIONS BY MEASURING THE LUMINESCENCE AND OPTICAL ABSORPTION OF INORGANIC AND ORGANIC SUBSTANCES. Frank, M.; Stolz, W. (Univ., Dresden). Kernenergie, 8: 541-57(Sept. 1965). (In German).

Inorganic dosimetric systems are described. These include: thermoluminescent dosimeters, infrared-stimulated-phosphor dosemeter, exoelectron emission measurements for dosimetry, radiophotoluminescence dosemeters, and glass coloration measurements for dosimetry. Organic dosimetric systems described include: dosimetry by fluorescent solutions, solids, or plastics and dosimetry by measuring the coloration of plastics. (128 references) (M.C.G.)

7391 IONIZATION CHAMBERS. Beck, J. (Allgemeine Elektricitaets-Gesellschaft, Munich). Kerntechnik, 7: 445-9(Oct. 1965). (In German).

A short introduction to the physical principles is followed by a general survey on the most important aspects for the construction of ionization chambers. A description is given of various types of ionization chambers for the detection of alpha, beta, and gamma rays as well as of neutrons. The ionization procedures typical for the different types of radiation and the corresponding ionization chambers are summarized in a table. (auth)

7392 D. C. AMPLIFIERS IN DOSIMETRY. Steudel, E. (Allgemeine Elektricitaets-Gesellschaft, Heiligenhaus, Ger.). Kerntechnik, 7: 450-4(Oct. 1965). (In German).

The attempt is made to define three different types of low-level d-c amplifiers: temperature measuring amplifiers with extreme low voltage drift, operational amplifiers with very great flexibility in applications, and d-c amplifiers for extreme low currents used especially in radiation measurement. For the last-mentioned type the correlations are discussed between the lowest detectable d-c signal and stability, drift, speed of indication. (auth)

7393 PULSE AMPLIFIERS. Boucke, G. (Telefunke AG, Ulm, Ger.). Kerntechnik, 7: 454-8(Oct. 1965). (In German).

For radiation measurements, two kinds of amplifiers are of general interest: linear and charge-sensitive amplifiers. For converting the charge pulse originating from a scintillation counter into a voltage pulse with defined base potential suitable for pulse height analysis, delay line pulse shaping, double RC or single RC pulse shaping with d-c restoring diode is used in linear amplifiers. Charge-sensitive amplifiers for semiconductor detectors were developed with respect to a signal-noise ratio as favorable as possible. For best noise performance, amplifiers with small parasitic input capacity and reasonably chosen band width are necessary; tubes prove to be today the best units in the first stage. (auth)

7394 A TIME-TO-PULSE HEIGHT CONVERTER FOR FAST NEUTRON SPECTROMETER OF TIME-OF-FLIGHT TYPE. Yoshimura, Atsushi (Tokyo Univ.); Sonoda, Masateru. Kyushu Daigaku Kogakuba Kogaku Shuho, 38: 28-37(Mar. 1965). (In Japanese).

A time-to-pulse height converter (T-H converter) of the nanosecond range is described. It is designed for a time-of-flight fast neutron spectrometer using the associated particle method. The T-H converter is of the pulse-overlapping type and uses 6BN6 as the gate tube. A detector for the associated alpha-particles is a thin plastic scintillator, viewed by a 6810 A photomultiplier, and a neutron detector is a 50 mm thick plastic scintillator, viewed by a 56AVP photomultiplier. The pulses from the two scintillators are transformed into the square pulses and applied to the first and third grids of the 6BN6 tube of the T-H converter. During the time in which both the pulses overlap, the 6BN6 tube is conducting and a voltage pulse, proportional to the overlap time, is produced by an integrating circuit in the plate circuit. The effects due to the changes in the control-grid biases, plate voltage, screen-grid voltage and filament voltage of the 6BN6 tube are measured, and the methods for reducing the magnitudes of these effects are described. The linearity of the T-H converter is very good up to the time difference of 50 nsec and the overall resolution is 1.9 nsec. Using 14 Mev neutrons, the ground state and excited states of $Q = -4.47, -7.6$, and -9.61 Mev of carbon nuclei are well resolved. (auth)

7395 EXPERIMENTAL OBSERVATIONS CONCERNING A SLOW-FAST COINCIDENCE CIRCUIT OPERATING IN THE 10^{-8} SEC. RANGE. Mathe, Gyoergy (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Magyar Fiz. Foly., 13: 337-51(1965). (In Hungarian).

A coincidence circuit was built for operation at a resolution of 10^{-8} sec. Its components included a circuit generating signals of varying amplitude; a delaying circuit, allowing families of coincidence curves to be measured; a coincidence stage; an integral discriminator, allowing the resolution to be varied; a slow-coincidence stage, for slow-fast coincidence measurements. The optimum measurement parameters were determined by examining the energy of coincident nuclear spectral lines. Alpha particles, deuterons, protons, and electrons could be separated by means of pulse-stage discrimination using a CsI(Tl) crystal. Steps were taken to filter out piled-up pulses in order to be able to measure high-energy low-intensity lines. (TCO)

7396 HIGH SPEED ROTORS FOR NEUTRON EXPERIMENTS. Hagihara, Satoshi; Watanabe, Mitsuhito (Mitsubishi Electric Mfg. Co., Ltd., Japan). Mitsubishi Denki Giho, 39: 1116-22(Sept. 1965). (In Japanese).

High speed rotors are represented by turbine disks, generator rotors, and centrifuge rotors, all having peripheral speeds close to the speed of sound or sometimes above it. Descriptions are given of various kinds of rotors built for the purpose of making mechanical separation and selection of neutron beams emitted from a reactor. Problems concerning burst strength and rotor life are discussed. (auth)

7397 OPTICAL STUDY OF AN ION DETECTOR OF ENERGY INDEPENDENT SENSITIVITY. Brisse, J.; Renaud, C. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Nucl. Instrum. Methods, 37: 9-12(Nov. 1965). (In French).

Computation of electronic and ionic trajectories, applied to the study of an ion detector, permits the optics of a detector to be determined. The range of detection of positive ions is extended from some ev to some hundred kev with an almost constant efficiency. (auth)

7398 TRANSISTORIZED TIME-TO-AMPLITUDE CONVERTER. Jones, G.; Falk, W. R. (Univ. of British Columbia, Vancouver). Nucl. Instrum. Methods, 37: 22-8 (Nov. 1965).

The design and performance characteristics of a transistorized time-to-amplitude converter is presented. This converter, which works on the principle of pulse overlap, is able to be used for measurements spanning a time range of a half microsecond with an electronic time resolution of less than 2×10^{-10} sec. (auth)

7399 AN EVENT GATE MODULE FOR SPARK CHAMBER EXPERIMENTS. Rudnick, S. J.; Metz, A. J. (Argonne National Lab., Ill.). Nucl. Instrum. Methods, 37: 29-35(Nov. 1965).

The instrument described is designed for spark chamber experiments in which more than one event per beam spill is to be recorded. The instrument generates gate pulses that turn off selected logic and scaling circuits during the intervals between beam spills, during each spark chamber discharge, and during film advance or on-line data processing. Thus, well defined artificial "dead times" are introduced. Timing pulses denoting the beginning and end of each beam spill must be supplied externally, but the other artificial "dead times" can be determined either internally or externally. The instrument also provides trigger pulses for spark chamber drivers and recording circuitry. (auth)

7400 RESOLUTION CORRECTIONS FOR β-RAY SPECTRA OBTAINED WITH ORGANIC SCINTILLATORS. Slavinskas, D. D.; Kennett, T. J.; Prestwich, W. V. (McMaster Univ., Hamilton, Ont.). Nucl. Instrum. Methods, 37: 36-42(Nov. 1965).

A method for applying response corrections to β spectra obtained with organic scintillators is presented. The method is based on writing the full response matrix as a product of two simpler matrices and making corrections for each product in turn. Results indicate that the simple first correction is sufficient to yield very nearly linear Fermi plots. Since only one parameter is required to carry out this correction, data can be processed without previous examination. (auth)

7401 THE SPARK TUBE. Bacon, D. F.; Nash, W. F. (Univ. of Nottingham, Eng.). Nucl. Instrum. Methods, 37: 43-4(Nov. 1965).

Results are given of a preliminary test on a device intended to replace conventional flash tube detectors. This device combines the advantages of automatic electronic data transfer with the retention of visual inspection for all events by photographic recording when required. It is based on a modification to existing flash tube design, and measurements indicate that efficiencies close to 100% for both visual and electronic operation may be readily obtained. (auth)

7402 THREE-PHOTON COINCIDENCE AND LIFETIME APPARATUS FOR POSITRONIUM IN GASES. Bell, J.; Celitans, G. J.; Green, J. H.; Tao, S. F. (Univ. of New South Wales, Kensington, Australia). Nucl. Instrum. Methods, 37: 51-7(Nov. 1965).

Three-photon coincidence equipment for studies on positron annihilation in gases is described. The detectors are simple photomultipliers and plastic phosphors which provide shorter pulses and smaller resolving time than NaI phosphors. Side-channel analyzers are incorporated to handle these shorter pulses. Equipment for associated studies of positron lifetime is also described. The range is 360 nsec with a resolution of 3.5 nsec. (auth)

7403 SECONDARY DISCHARGES AND CURRENT PATH SPLITTING IN DIVIDED ELECTRODE SPARK CHAMBERS. Bacon, D. F.; Nash, W. F. (Univ. of Nottingham, Eng.). Nucl. Instrum. Methods, 37: 61-8 (Nov. 1965).

Phenomena of spark-less discharges and current path

splitting in printed circuit type divided electrode spark chambers are investigated, and mechanisms are suggested in terms of the streamer theory of spark formation to adequately explain the characteristic properties observed in special test chambers. It is shown that spark-less discharges may be avoided by minimizing the value of discharge capacity and that current path splitting may be greatly restricted by appropriate choice of electrode geometry, the optimum conditions found during measurements being given in each case. (auth)

7404 APPARATUS FOR ELECTRON-GAMMA ANGULAR CORRELATION MEASUREMENTS. Kukoc, A.; Marinkov, L. (Inst. of Nuclear Sciences Boris Kidrich, Belgrade). Nucl. Instrum. Methods, 37: 77-82(Nov. 1965).

An apparatus for electron-gamma angular-correlation measurements is presented. Coefficients for finite angular resolution of the beta spectrometer are determined by Gerholm's method and the collimated-electron-beam method. The equipment is checked by measuring the electron-gamma angular correlation of the 4^+(E2, 468 kev, K)2^+(E2, 316 kev, γ)0^+ cascade in ^{192}Pt. Within the experimental error ($A_2 = 0.137 \pm 0.010$), agreement with the theory is found. (auth)

7405 GLASS BF_3 PROPORTIONAL COUNTERS AND THEIR LOW TEMPERATURE CHARACTERISTICS. Fenton, A. G.; Fenton, K. B. (Univ. of Tasmania, Hobart, Australia). Nucl. Instrum. Methods, 37: 83-9(Nov. 1965).

Glass envelope BF_3 proportional neutron counters of simple construction have been made for balloon-borne cosmic ray equipment. Both internal and external cathode counters having soda-lime envelopes with a BF_3 filling pressure of 45 cm Hg are described. These counters have a resolution of 15% fwhm after standing for 2½ years and there is no evidence for deterioration of their characteristics over this period. Some improvement in resolution is reported at reduced temperatures, at least down to −60°C, the lowest investigated. However, at low temperatures the wall resistance of external cathode counters must be considered, especially if high counting rates and high gas gains are to be used. (auth)

7406 NEW POSSIBILITIES OF SILICON p-n JUNCTIONS IN NUCLEAR PARTICLE DETECTORS. Blanc, D. (Faculte des Sciences, Toulouse); Casanovas, J.; Chapuis, A.-M.; Soudain, G. Nucl. Instrum. Methods, 37: 90-2 (Nov. 1965). (In French).

By measuring the number of electric charges produced through ionization in a silicon surface-barrier p-n junction, it is possible to evaluate the absorbed dose of each type of particles in a complex beam of α, β, and γ rays and to be aware of the collection share of each such radiations. The detector and the results obtained with α, β, and γ sources of various energies are described. (auth)

7407 CALCULATED EFFICIENCIES OF Ge(Li) DETECTORS. Hotz, H. P.; Mathiesen, J. M.; Hurley, J. P. (Naval Radiological Defense Lab., San Francisco). Nucl. Instrum. Methods, 37: 93-7(Nov. 1965).

Gamma-ray detection efficiencies for Ge(Li) detectors were calculated on an IBM 704 computer for crystals of 1.0 × 2.0 cm and 2.0 × 3.0 cm cross section. Depletion depths from 1.0 to 10.0 mm and source-to-crystal distances from 1.0 to 25.0 cm were selected. (auth)

7408 ON ANGULAR CORRELATION MEASUREMENTS BETWEEN FAST NEUTRONS. Adam, A.; Kozma, Gy.; Quittner, P. (Central Research Inst. of Physics, Budapest). Nucl. Instrum. Methods, 37: 98-103(Nov. 1965).

Principle and electronics of a measuring assembly developed for the investigation by time-of-flight technique of angular and energy correlations between two neutrons produced simultaneously are described. Counts owing to events caused by both detectors responding to a single neutron are suppressed by the electronics. Only coincidences from two different neutrons are counted. The assembly is tested with the 14.7-Mev neutrons from the D-T reaction. A slight change in counting efficiency, which is sensitive both to neutron energy and detector geometry, can be accounted for by calculation. (auth)

7409 RECORDING OF SIMULTANEOUS MULTI-DETECTOR NEUTRON DECAY CURVES. Carmeliet, J.; Kinet, Ph. (Univ. Libre, Brussels). Nucl. Instrum. Methods, 37: 104-8(Nov. 1965).

Separation of harmonics in pulsed-neutron-source experiments may be effected by measuring the neutron decay at several points of the medium. A pulse generator allowing for the simultaneous recording of four neutron decay curves with a time analyzer having a single detector input is described. (auth)

7410 A NEW GAIN STABILIZING SYSTEM FOR SCINTILLATION SPECTROMETERS. Comunetti, A. M. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Nucl. Instrum. Methods, 37: 125-34 (Nov. 1965).

A method is described for stabilizing the overall gain of scintillation spectrometers. A mechanically chopped reference γ source controls the gain by pulse-frequency difference feedback. This method allows complete separation of the reference spectrum and the analyzed spectrum. The general theory of a device with analog integrator is developed and a particular stabilizer with reference source and standard oscillator is described. (auth)

7411 PION STUDIES WITH SILICON DETECTORS. Raju, M. R.; Aceto, H.; Richman, C. (Univ. of California, Berkeley). Nucl. Instrum. Methods, 37: 152-8(Nov. 1965). (UCRL-16071).

Measurements are made of the most probable energy loss in silicon for pions of energies extending from 365 to 50 Mev. The results agree within 2% with the theoretical values. The behavior of the pion beam with its inherent muon and electron contaminants, as it passes through various thicknesses of absorbing material, is displayed. The energy distribution of negative pion stars in silicon is measured and found to be a constantly decreasing function of energy, with the high-energy tail extending beyond 60 Mev. (auth)

7412 OPERATION OF THE MICROWAVE DISCHARGE CHAMBER. Ohashi, Y.; Tsukishima, T. (Nagoya Univ., Japan). Nucl. Instrum. Methods, 37: 159-60(Nov. 1965).

A microwave discharge chamber is described, in which a particle traversing the sensitive volume produces a series of spot-type discharges that can be used for three-dimensional spatial resolution of the particle trajectory. The magnetron used in the instrument operates in the TE_{10} mode at 5.55 Gc, with a peak power of 250 kw and a pulse width of 100 nsec. (T.F.H.)

7413 IONIZATION DENSITY MEASUREMENT IN THE MICROWAVE DISCHARGE CHAMBER. Ohashi, Y.; Washimi, H. (Nagoya Univ., Japan). Nucl. Instrum. Methods, 37: 162-4(Nov. 1965).

The ionization densities in spot-type discharges in microwave discharge chambers are measured. 500-Mev electrons and 30- and 120-Mev protons are used to excite the discharges. The effects of pressure and atomic weight of the filling gas on the chamber performance are discussed. (T.F.H.)

7414 THE USE OF A LITHIUM DRIFTED GERMANIUM DETECTOR TO OBSERVE THE DE-EXCITATION GAMMA RAYS PRODUCED BY THE INELASTIC SCATTERING OF 2.9 Mev NEUTRONS BY COBALT AND COPPER. Christie, D. R.; Daniels, J. M.; Felsteiner, J. (Univ. of Toronto). Nucl. Instrum. Methods, 37: 165-7(Nov. 1965).

Gamma spectra from inelastic scattering of 2.9-Mev neutrons by ^{59}Co, ^{63}Cu, and ^{65}Cu are measured, and energy-level and gamma-decay schemes for these nuclides are inferred from the data. The design of the lithium-drifted germanium detector used in the measurements is described. (T.F.H.)

7415 A VERSATILE VACUUM CHAMBER FOR SEMICONDUCTOR BETA AND GAMMA DETECTORS. Benvenuti, A.; Blasi, P.; Maurenzing, P.; Sona, P. (Univ., Florence). Nucl. Instrum. Methods, 37: 168-70(Nov. 1965).

The vacuum chamber described has the following features: capability of simultaneous use of several semiconductor detectors, and a scintillation detector, in the chamber; provision for source replacement and movement under vacuum; and provision for rapid insertion of sources into the chamber. The chamber is a cubical enclosure 28 cm on a side, designed for operating at 10 μ Torr and 78°K. (T.F.H.)

7416 COMPARISON OF CHARACTERISTICS OF SOME MULTIPLE-WIRE SPARK COUNTERS. Kawata, S. (Konan Univ., Japan). Nucl. Instrum. Methods, 37: 171-3 (Nov. 1965).

Electric characteristics are discussed of multiple-wire spark chambers having either a 10-MΩ resistor in series with each wire, or wire-cavity configurations, or guard wires alternating with anode wires. The relative performances of these three systems for eliminating wire-interaction effects are compared. (T.F.H.)

7417 MEASUREMENT OF ELECTRON INDUCED SHOWERS WITH THERMOLUMINESCENT DOSIMETERS. Jenkins, Th. M.; Cobb, J. K.; Nelson, W. R.; McCall, R. C. (Stanford Univ., Calif.). Nucl. Instrum. Methods, 37: 174-5(Nov. 1965).

The design of a thermoluminescent detector consisting of parallel LiF-filled polythene tubes imbedded in an iron block is described. The use of the detector for monitoring the electromagnetic shower production by a 1-Bev electron beam from the Stanford Linear Accelerator is detailed. (T.F.H.)

7418 FLUCTUATIONS OF ENERGY LOSS BY HEAVY CHARGED PARTICLES IN SILICON DETECTORS: PRELIMINARY MEASUREMENTS. Maccabee, H. D.; Raju, M. R. (Univ. of California, Berkeley). Nucl. Instrum. Methods, 37: 176-8(Nov. 1965).

The probability distributions of energy losses of 730-Mev protons and 370-Mev pions in 0.48-g/cm^2 and 0.45-g/cm^2 Si detectors, respectively, are measured over the energy-loss range of 0.5 to 1.4 Mev. The results are compared with the Vavilov and Landau theories for the proton and pion energy losses, respectively. Explanations are proposed for the discrepancies noted. (T.F.H.)

7419 LARGE AREA SCINTILLATION COUNTERS. Ashton, F.; Coats, R. B.; Holyoak, B.; Simpson, D. A.; Thompson, M. G. (Univ. of Durham, Eng.). Nucl. Instrum. Methods, 37: 181-2(Nov. 1965).

The performances of large-area (1.24 m^2 liquid-scintillator and 0.76 m^2 plastic-scintillator) scintillation detectors are measured and compared. Both counters use two photomultipliers, situated along opposite edges of the phosphor, which is in a rectangular-sheet configuration. The maximum nonuniformities of response of the detectors as functions of the position of the scintillation pulse are measured, and found to lie between 18 and 36%. The resolutions of the detectors are also measured and compared. The liquid scintillators used are paraffin and paraffin–10% Shellsol A, and the plastic scintillator used is NE 102. (T.F.H.)

7420 A SPECTRUM STABILIZER USING READY-MADE DIGITAL CIRCUIT MODULES. Borbas, R. (Digital Equipment of Canada, Carleton Place, Ont.); Doyle, D. J.; Aitken, J. H.; Jones, L. Nucl. Instrum. Methods, 37: 183-4(Nov. 1965).

A spectrum stabilizer is described that can be used in conjunction with any multichannel pulse-height analyzer employing analog-to-digital conversion. Drifts in the position of a given peak in the pulse-height spectrum cause the stabilizer to generate a correction voltage, which can return the peak to its original position. The stabilizer uses commercial digital-circuit modules. The use of the stabilizer in conjunction with a scintillation spectrometer is described. In this case, the correction voltage can be conveniently applied to the photomultiplier high-voltage supply, in order to change the photomultiplier gain. (T.F.H.)

7421 RADIOISOTOPE TECHNIQUES IN BIOLOGY—PART I. MEASURING RADIOISOTOPES IN ORGANIC COMPOUNDS. Christman, David R. (Brookhaven National Lab., Upton, N. Y.). Nucleonics, 23: No. 12, 39-45(Dec. 1965).

The properties of and the problems involved with each of the major counting methods used with biological samples are briefly outlined. The criteria for selecting among liquid or solid scintillators, ion chambers, or gas counters for measuring beta particles from ^{3}H, ^{14}C, or ^{35}S labeled compounds are discussed. (L.B.S.)

7422 PROBLEMS WITH SEMICONDUCTOR DETECTORS DUE TO ANOMALOUS ENERGY LOSS. Wegner, H. E. (Brookhaven National Lab., Upton, N. Y.). Nucleonics, 23: No. 12, 52-6(Dec. 1965).

A series of measurements were made of energy distributions of monoenergetic protons and ^{4}He ions after penetrating silicon crystals in order to study the channeling effects on data obtained with semiconductor detectors. The energy-loss and multiple-scattering effects are discussed. (L.B.S.)

7423 A COMMENT ON THE FORMULA FOR THE ELIMINATION OF SPURIOUS SCATTERING. Kamal, A. A. (Osmania Univ., Hyderabad, India). Nuovo Cimento (10), 40A: 668-9(Nov. 21, 1965).

The equivalence of the method proposed by Iursonov et al. for the elimination of spurious scattering in nuclear emulsions, which uses the second and third difference, and the method of cross products due to Molière is pointed out, by deriving the equation for the former method starting with that for the latter. (M.J.T.)

7424 ON IMPURITIES EFFECTS IN He SCINTILLATION. Guazzoni, P.; Pignanelli, M. (Univ., Milan). Nuovo Cimento (10), 40B: 454-6(Dec. 11, 1965).

A high-pressure He scintillation counter with good performance and stability was built. The counter chamber with a quaterphenyl-phosphor coated window and Al-quaterphenyl or Al–MgO–quaterphenyl reflector was outgassed and heated in order to eliminate time variation of the light output due to desorption of gases occluded on the chamber walls. Preliminary results on the effects of N_2 and O_2 impurities in the He gas on the energy resolution and pulse height are discussed. (M.J.T.)

7425 ARRESTING LATENT-IMAGE FADING IN DOSIMETRIC FILMS. Markow, Basil (Army Electronics Command, Fort Monmouth, N. J.). Photogr. Sci. Eng., 9: 353-4(Nov.-Dec. 1965).

Experiments conducted in an effort to eliminate latent-image fading in dosimetric film are discussed. The films were exposed to radiation from a 250-Kv constant-potential x-ray machine operated at 10 ma with an inherent filtration of 3 mm Al. The films were all developed together one hour after the end of the last exposure. The effects of temperature on latent-image fading were studied. Film exposed at ambient temperatures and stored at –78°C did not fade, while film exposed and stored both at –78°C not only did not fade but was also less sensitive. It was also found that vacuum packaging without continuous pumping will also arrest latent-image fading. (F.J.H.)

7426 CALCULATIONS FOR CHERENKOV GAMMA SPECTROMETERS. Grushin, V. F.; Latypova, R. A.; Leikin, E. M. (Inst. of Physics, Academy of Sciences, USSR). Prib. Tekh. Eksp., No. 5, 40-4(Sept.-Oct. 1965). (In Russian).

The results of the calculation of the basic characteristics of complete absorption Cherenkov γ spectrometers with lead glass radiators of different transparency and thickness for γ energies of 50 to 1000 Mev were reported. (tr-auth)

7427 RATE CHARACTERISTICS OF CHERENKOV TOTAL ABSORPTION SPECTROMETERS. Aleksandrov, Yu. A.; Kutzenko, A. V.; Maikov, V. N.; Pavlovskaya, V. V. (Inst. of Physics, Academy of Sciences, USSR). Prib. Tekh. Eksp., No. 5, 45-8(Sept.-Oct. 1965). (In Russian).

For improvement of the rate characteristics of complete-absorption Cherenkov spectrometers in conjunction with the FEU-49 spectrometer, the FEU-36 was used temporarily. This made it possible to obtain resolving times $\tau \approx 4$ to 5×10^{-9} sec during conservation of 100% efficiency

of the recording of γ quanta in the energy range from 100 to 600 Mev. (tr-auth)

7428 MAGNETIC COMPTON SPECTROMETER FOR STUDYING SHORT-LIVED ISOTOPES. Sergeev, A. G.; Voinova, N. A.; Dzhelepov, B. S.; Kalinichev, Yu. V.; Kaminker, D. M. (Inst. of Physics and Tech., Leningrad). Prib. Tekh. Eksp., No. 5, 48-53(Sept.-Oct. 1965). (In Russian).

The magnetic Compton spectrometer, the elotron, makes it possible to attain sufficiently complete and precise data on the γ radiation of radioactive nuclei. The apparatus described was adapted specially for the study of short-lived isotopes, formed in (n,γ) reactions. It was installed near the VVR-M Reactor for rapid transfer of the exposed preparations from the active zone of the reactor to the spectrometer using pneumomatic tubes. The installation of the apparatus and its basic characteristics are described. (tr-auth)

7429 FAST NEUTRON SPECTROMETER. Okorokov, V. V.; Tolchenkov, D. L. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 5, 53-7(Sept.-Oct. 1965). (In Russian).

A time-of-flight fast neutron spectrometer is described. The operation of the multichannel nanosecond analyzer of the vernier type was examined during lack of stabilization of the basic parameters of the cyclotron (amplitude and frequency of the high-frequency voltage). (tr-auth)

7430 REFINEMENT OF NEUTRON SELECTOR AND MEASUREMENTS OF FIRST RESONANCES IN COPPER AND ZINC. Ignat'ev, K. G.; Kirpichnikov, I. V.; Soldatov, A. N.; Sukhoruchkin, S. I.; Kharitonov, A. D. (Inst. of Experimental and Theoretical Physics, Moscow). Prib. Tekh. Eksp., No. 5, 58-60(Sept.-Oct. 1965). (In Russian).

The establishment of the precise phase ratio between the moment of formation of the neutron pulse and the trigger of the analyzer and the utilization of the time–amplitude–time converter on a standard pulse made it possible to reduce the resolving capacity to ~5 nsec/m. More precise measurements of the first resonance levels gave E_0 = 229.3 ev for ^{65}Cu and E_0 = 222.8 ev for ^{67}Zn. (tr-auth)

7431 DETERMINATION OF ENERGIES OF ELECTRONS IN THE INTERVAL 20 TO 250 Mev IN XENON BUBBLE CHAMBER. Kurbatov., V. S.; Mal'tsev, E. I.; Maslakov, A. I.; Stashkov, G. M.; Chuvilo, I. V.; Shklovskaya, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 5, 61-3(Sept.-Oct. 1965). (In Russian).

The method for the determination of the energy of electrons in the interval from 20 to 250 Mev is described. The nonlinear form of the dependence $E_e = f(R_e)$ was proposed. The precision of the method described for the determination of the energy of the individual electrons and γ quanta was ≈20%. (tr-auth)

7432 SEMIAUTOMATIC DEVICE FOR MEASURING PHOTOTRACKS OF CHARGED PARTICLES. Stabnikov, M. V.; Trukhano, B. G.; Dobyrn, V. V.; Mishchenko, I. S.; Lukashunas, N. I. (Inst. of Physics and Tech., Leningrad). Prib. Tekh. Eksp., No. 5, 63-6(Sept.-Oct. 1965). (In Russian).

A device for the measurement of photographic tracks of charged particles is described. The coordinates of the tracks on the photograph can be immediately and automatically recorded on perforated cards with the device. This speeds up the measurement process more than 10 times. (tr-auth)

7433 GAS COUNTERS FOR RECORDING ULTRA-SOFT X RADIATION. Lukirskii, A. P.; Brytov, I. A. (Leningrad State Univ.). Prib. Tekh. Eksp., No. 5, 66-70 (Sept.-Oct. 1965). (In Russian).

The operational specifications of Geiger counters and proportional counters for ultra-soft x radiation (23.6 to 200 Å) were examined. The data making it possible to determine the efficiency of the counters were reported. The results showed that proportional counters with methylal filling gave the best performance. (tr-auth)

7434 PROPORTIONAL COUNTER CONSTRUCTION AND TECHNICAL SPECIFICATIONS. Klyukvina, E. F.; Chaikovskii, V. G.; Nikol'skii, A. P.; Evlanov, I. Ya. Prib. Tekh. Eksp., No. 5, 71-3(Sept.-Oct. 1965). (In Russian).

The construction and technical specifications of a proportional circulating counter, designed for the recording of x radiation in the energy range from 1 to 10 kev, are described. The method for the determination of the efficiency of the counter is given. (tr-auth)

7435 INVESTIGATION OF SCINTILLATION COUNTER PERFORMANCE BY MEANS OF THE STEEP-ASCENT METHOD. Luk'yanov, V. B.; Maximov, V. N. (Moscow State Univ.). Prib. Tekh. Eksp., No. 5, 73-7(Sept.-Oct. 1965). (In Russian).

For investigation of the work regime of scintillation counters, the steep rise method was used. It was shown that the region of optimum regime was very wide. The optimum work regime of scintillation counters can be found by fixed voltage on photoelectron tubes by variation of the amplification factor at the input of the discriminator and discrimination level. (tr-auth)

7436 INTEGRATING DETECTOR FOR DETERMINING SHORT NEUTRON PULSE INTENSITY. Gorbachev, V. M.; Uvarov, N. A. Prib. Tekh. Eksp., No. 5, 77-82 (Sept.-Oct. 1965). (In Russian).

The use of integral scintillation counters, based on the delayed registration method, for the determination of the pulse intensity of neutron sources was examined. The specification individuality of the detector is a very wide range of registration, up to 10^5, at sensitivity of 0.05 neutrons/cm^2. The design and a short description of the recording apparatus is reported. Different variants of the design of the integral counter are shown. (tr-auth)

7437 WIDE-RANGE RATE METER. Gorbachev, V. M.; Maslov, G. N.; Uvarov, N. A. Prib. Tekh. Eksp., No. 5, 82-5(Sept.-Oct. 1965). (In Russian).

The design of the device, making it possible to record the change of the pulse intensity of radioactive preparations in time during monotonous decrease of the intensity, is described. (tr-auth)

7438 THE INFLUENCE OF THE CONTACT SURFACE ON EFFICIENCY OF SILICON COUNTERS FOR FISSION FRAGMENTS. Dyachenko, P. P.; Kuzminov, B. D.; Chukichev, M. V. Prib. Tekh. Eksp., No. 5, 85-8(Sept.-Oct. 1965). (In Russian).

In the results of the investigation of two sets of surface-barrier counters with different condition of the surface, it was found that the presence of craters on the counter surface is a basic cause for the appearance of "tails" in the amplitude distribution of the pulses, created by fission fragments, and hampers the attainment of information from fragments with low yield. (tr-auth)

7439 PREAMPLIFIER FOR NUCLEAR RADIATION TRANSISTOR DETECTORS. Babushkin, A. A.; Mednikov, A. K. (Inst. of Nuclear Physics, Academy of Sciences, Alma-Ata, USSR). Prib. Tekh. Eksp., No. 5, 88-91(Sept.-Oct. 1965). (In Russian).

The principal design of charge-sensitive preamplifiers, intended for work with transistorized detectors, having self-capacity up to 1000 nf, is described. Recommendations on the adjustment were given and the characteristics of the preamplifier are reported. (tr-auth)

7440 DEVICE FOR MEASURING MOESSBAUER SPECTRA. Valov, P. V.; Sokolova, V. K.; Vilenskii, A. G.; Vainshtein, E. E. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Prib. Tekh. Eksp., No. 5, 161-3(Sept.-Oct. 1965). (In Russian).

A Mössbauer spectrometer with variable speed is described. Its basic connections were made from standard instruments. The operation of the spectrometer is based on the principle of the modulation of the pulses from a γ detector with linear conversion so that the amplitude is proportional to the speed of motion of the source relative to the absorber. The design of the pulse-height modulator and of the fixed-voltage amplifier is described. (tr-auth)

7441 PREPARATION OF ZINC SULFIDE SCINTILLATION SCREENS. Nikolaev, Yu. M.; Kanishchev, E. I. Prib. Tekh. Eksp., No. 5, 231-2(Sept.-Oct. 1965). (In Russian).

A method for the fixing of scintillation films to organic glass supports is described. The efficiency of two scintillation screens, with differing method of fixations of the zinc sulfide, is compared. (tr-auth)

7442 MEASUREMENT INSTRUMENT FOR THE MEDICAL ISOTOPE LABORATORY. Potschwadek, B. (Univ. Rostock, Ger.). Radiobiol. Radiotherap., 5: 491-3(1964). (In German).

A device for measuring and recording radioisotope scanning data is described. It consists of a high-voltage unit, amplifier, analyzer, and recording instrument. The input pulses are amplified, led through a pulse shaper, and five decade counters, or they can be selectively scaled to operate an electromechanical printer. This equipment is intended for studies of localization of radioisotopes in tissues and organs as well as for measurements of radioisotope samples. The equipment is capable of measurements of count values of 1, 2, 4, and 10 in multiples of 10, up to 400,000 counts. (BBB)

7443 UTILIZATION OF IONIZATION CHAMBERS FOR ESTIMATION OF AVERAGE ENERGY OF FAST NEUTRONS IN RADIOBIOLOGICAL EXPERIMENTS. Bregadze, Yu. I. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 744-51(1965). (In Russian).

A simple method is proposed for estimating the average, fast neutron energy in a mixed flux of fast neutrons and gamma radiation by the use of ionization chambers. The ionization current in a hydrogen-containing chamber irradiated with fast neutrons is due to recoil protons knocked out of the chamber wall (wall effect) and to protons originating in the gas volume (volume effect). If the recoil proton range is comparable with the dimensions of the gas volume or cavity, the ratio of the wall to volume effects depends strongly on the fast neutron energy. The average neutron energy can be estimated by determining this ratio experimentally and comparing it with the theoretical values calculated for various fast neutron energies. Two ionization chambers which were made of polyethylene and graphite and were filled with CO_2 and ethylene were used to estimate the fast neutron and gamma fluxes. The average fast neutron energy did not undergo any substantial changes along the length of the channel, but remained constant at a value of 1.3 to 1.6 Mev which was an average fission neutron energy. The fast neutron spectrum did not change on passing through a layer of polyethylene 7 cm thick. (TTT)

7444 USE OF POLYACRYLAMIDE WATER SOLUTION FOR DOSIMETRY OF IONIZING RADIATIONS. Kuznetsova, S. S. Radiobiologiya, 5: 775-9(1965). (In Russian).

Certain organic polymers change their molecular weight and thus their viscosity when exposed to ionizing radiation and therefore may be used for dosimetric measurements. Aqueous solutions of polyacrylamide (PAA) having a molecular weight of 6×10^6 may be used to measure radiation doses in the range from 50 to 7500 rad with a precision of ±20%. Two opposite processes, cross linkage and destruction of the structure, are involved in the process. In comparison with polystyrene and polyisobutylene in CCl_4 solution, the viscosity changes induced in aqueous PAA solutions were found to be more significant. Their use in dosimetry presents the advantage that no volatile organic solvent is needed. The working solutions had a concentration between 0.01 and 0.07%, depending on the molecular weight of the material and the type of viscosimeter used. The method may be expected to find wide application in radiobiological dosimetric investigations. (TTT)

7445 HYBRID NEUTRON SPECTROMETER SYSTEM. Kotov, B. A.; Okuneva, N. M.; Shakh-Budagov, A. L. (Semiconductor Inst., Academy of Sciences, Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 7: 1146-7(Nov. 1965).

Translated from Fiz. Tverd. Tela, 7: 1423-24(May 1965).

An apparatus for the investigation of materials in the condensed state was constructed. In this apparatus a monochromatic beam of incident neutrons is obtained by reflection from the (111) plane of an aluminum single crystal. (auth)

7446 PROBLEMS OF DOSIMETRY AND PROTECTION AGAINST RADIATION. Vopr. Dozimetr. i Zashchity ot Izluchenii, Mosk. Inzh. Fiz. Inst., Sb. Statei, No. 4,1-149(1965). (In Russian).

Twenty four articles are included on the problems of radiation protection and dosimetry. Fast neutron threshold dosimeters are discussed and thirteen materials for measuring neutron spectra in the energy range from 0.46 ev to 6 kev are described. A brief review is given of the performance and use of silicon and germanium γ detectors and the methods of γ and β radiometry. The measurements of bremsstrahlung dose field in a 2.5-Mev accelerator are presented. The development of nuclear reactors during the period 1957 to 1964 is reviewed, and data are given on the level of atmosphere contamination. Remarks are made on the dispersion time of electrons in flight in a photo multiplier and a method is suggested for estimating optimum scintillators for single crystal fast neutron spectrometers. A scheme of a semiconductor amplitude discriminator with threshold near 5 mv and time reduction of 0.1 μsec is discussed as well as the scheme for stabilizing the amplification factor in fast neutron spectrometers. (R.V.J.)

7447 THE CORRECTION FOR THE γ SENSITIVITY OF THE β COUNTER IN THE 4π β-γ COINCIDENCE METHOD. Koehler, W. (Technische Hochuschule, Munich). Z. Naturforsch., 20a: 1170-4(Sept. 1965). (In German).

In most studies a scintillation crystal is used in the 4π β-γ coincidence method for γ detection. The correction for γ-γ coincidences that is necessary in isotopes of two or more γ quanta per decay was investigated by Campion and Williams for such a measuring device. Proportional counters can also be used for γ detection. For the simple β-γ coincidence method, Wolf has a given a method for the determination of necessary corrections. The method proposed by him was also investigated for 4π β-γ measurements. The extrapolations necessary however causes error possibilities. The determination of this decay scheme corrections was carried out in two different experimental techniques for ^{60}Co and ^{24}Na preparations. For a ^{60}Co preparation with $\epsilon_\beta = 0.84$ a correction of +0.10% with a maximum error of ±0.5 was obtained. The transference of this correction to other preparations and isotopes, as for instance ^{46}Sc, was discussed. (tr-auth)

7448 MEASUREMENTS OF LIFE TIMES OF EXCITED NUCLEAR LEVELS USING A TRANSISTORIZED TIME-TO-PULSE HEIGHT CONVERTER [Thesis]. Bloess, D. Brunswick, Ger., Tech. Univ., 1964. 73p. $2.00 Gmelin, AED-DISS. 64-575.

Design of a transistorized time-to-pulse height converter is described. Life times of the following levels are given: 81 kev in ^{133}Cs, 145 kev in ^{141}Pr, 87 and 105 kev in ^{155}Gd, 80 kev in ^{198}Er, 100 and 1290 kev in ^{182}W. (Gmelin Inst.)

7449 MEASUREMENT OF SHORT LIVED NUCLEAR LEVELS WITH NANOSECOND TECHNIQUES [Thesis]. Stary, F. Dresden, Tech. Univ., 1964. 164p. $2.00 Gmelin, AED-DISS. 64-749.

A coincidence spectrometer with a time-to-pulse height converter is described. Results of lifetime measurements of levels of ^{95}Mo, ^{99}Tc, ^{170}Yb, ^{181}Ta, and ^{203}Tl are given. (Gmelin Inst.)

7450 A STUDY OF THE INFLUENCE OF FABRICATION TECHNIQUES ON THE BULK MINORITY CARRIER LIFETIME IN SILICON RADIATION DETECTORS [Thesis]. Jones, Ernest Olin. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1964. 64p.

The minority carrier lifetime of several samples of silicon was measured at various stages in the preparation of lithium-drifted silicon radiation detectors fabricated by two different techniques. Each stage of the processes that appeared to result in lifetime changes was investigated. Processing, including lithium drift, resulted in a lifetime

loss of 49% of the initial value by one method and 58% by another. Those techniques involving treatments at high temperatures (around 1050°C) were found to have more influence in reducing lifetime. The presence of both lithium and phosphorus was found to reduce the severity of lifetime loss. With these materials in the samples, reduction in lifetime was less if the samples were quenched after diffusion rather than cooled slowly. An oxygen atmosphere during heat treatments was noted to result in a smaller loss in lifetime than atmospheres of argon or a nitrogen-hydrogen mixture. In the examination of fabrication techniques the diffusion of phosphorus at 1050°C and of lithium at 400°C each resulted in substantial lifetime losses. The process of lithium drift in oil at 150°C appeared to have little effect on the sample lifetime. A preferred fabrication procedure could not be selected based on lifetime loss. Annealing in the temperature range of 300-500°C for six hours in various atmospheres was found to restore a portion of the lifetime lost in prior heat treatment. More recovery was noted in an oxygen atmosphere than in argon. A possible mechanism for the annealing results was proposed based on the Kaiser model of donor formation by oxygen dissolved in silicon. (Dissertation Abstr.)

7451 NUCLEONIC INSTRUMENTATION. Washtell, C. C. H.; Hewitt, S. G. Newnes Practical Science Books. London, George Newnes Limited, 1965. 152p. 42s.

Information covering the function and performance, and the circuit techniques employed in instruments using electronic circuits is presented. A nonmathematical treatment is followed, and a basic understanding of circuit functions, instrument uses and maintenance is given. Circuit components and elements, instrument construction, pulse amplifiers, counters and scaling units, cold-cathode counting tubes and allied devices, pulse-height discriminators, ratemeters, power supplies, automatic equipment, and servicing and maintenance are included. (J.F.P.)

7452 MONITORING INSTRUMENTATION - HRLAL, BUILDING 2026 /Q-2336/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–1274).

17 drawings.

The modernized, process water monitoring system used in the High Radiation Level Analytical Laboratory (HRLAL) is described. The laboratory consists of 7 hot cells, 1 storage cell, and supporting facilities. The monitoring system includes Monitrons; a sampler for an air duct, stack monitor; count rate meter; and an instrument used in measuring the liquid level in a waste monitoring tank. (For details, see TID-4100). (L.B.S.)

7453 CONSTANT AIR MONITOR (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–1241).

48 drawings.

A combined system of instruments is described for monitoring α and β particles and γ radiation. Part of the system is used to monitor β and γ radiations by use of a halogen-type Geiger-Mueller tube and a count rate meter, Q-2784, which has a normal range of 0 to 5,000 counts/min at full scale. Ranges of 0 to 250, 0 to 1,000, 0 to 10,000, and 0 to 25,000 counts/min can also be provided. Q-2340A is used with Q-2783, a linear count rate meter, to detect α particles. This instrument monitors α particles without a provision for rejecting α counts received from the normal radon and thoron in the air. The α monitor consists of an aspirating system, paper-tape filter, scintillation detector, linear count rate meter, recorder, and visible and audible alarms. The detector is a silver-activated zinc sulfide scintillator. The count rate meter contains a high-voltage supply as an integral part and has a normal range of 0 to 1,000 counts/min. Ranges of 2 to 250, 0 to 2,500, 0 to 5,000, and 0 to 10,000 counts/min at full scale can also be provided. The detectors, count rate meters, specifications, filter tape drives, panels and pumps are included in this package. (For details, see TID-4100). (L.B.S.)

7454 GAMMA RAY SPECTROSCOPY WITH A SCINTILLATION SPECTROMETER HAVING AN ANTICOINCIDENCE ANNULUS. Monahan, J.; Raboy, S.; Trail, C. C. (Argonne National Lab., Ill.). pp 5-15 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

The design is described of a Pb-shielded scintillation spectrometer for use in experiments in nuclear physics in a high radiation background. The principal detecting crystal was surrounded by another detector in anticoincidence. The response of the spectrometer was studied for γ rays from ^{60}Co and ^{137}Cs of energies up to 7.1 Mev and γ rays from ^{24}Na of 2.75 and 1.37 Mev energies. The background spectrum in the spectrometer was determined with the anticoincidence annulus functioning and 2 in. of Pb surrounding the crystals, photomultipliers, and preamplifiers and with no Pb around the spectrometer. Results of background measurements indicated no radioactivity within the crystal itself. Studies of γ ray spectra led to the development of a method of analysis which describes a full energy peak in terms of Gaussian function and permits full utilization of the statistical accuracy of the data. (C.H.)

7455 A MOBILE WHOLE BODY COUNTER. Von Doebeln, Wilhelm (Gymnastiska Centralinst, Stockholm). pp 25-6 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Design features are described of a mobile whole-body radiation counter that consists of a booth open at the top with 8 cm thick walls made of Pb bars. The case serves as a shield for a chair and a scintillation detector and is placed in a wagon with wooden walls and roof. Preliminary data are presented on the physical characteristics of the equipment. (C.H.)

7456 A PROGRESS REPORT ON THE MEASUREMENT OF PLUTONIUM IN VIVO. Taylor, B. T.; Rundo, J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 52-64 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965. (AERE-R–4144).

A proportional counter and plastic scintillator anticoincidence system is described that was developed for use in in vivo measurements of ^{239}Pu in the lungs of man. The counter uses a thin NaI crystal and a small Xe-filled proportional counter with Be window and is constructed from a lucite cylinder 15 cm long with an internal diameter of 14 cm with a thin film of Al evaporated on the inner surface to form the cathode with a connection through the wall to an external earth. The other end assembly consists of a lucite window and support for the central wire. Calibration of the counter is described and results are reported from preliminary measurements of radiations from whole-body ^{40}K and ^{137}Cs in human subjects and ^{235}U deposited in the lungs. (C.H.)

7457 A SCINTILLATION SPECTROMETER STABILIZATION SYSTEM. Dudley, Robert A.; Scarpatetti, Remigius (International Atomic Energy Agency, Vienna). pp 104-16 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

A gain stabilization system was developed for a scintillation spectrometer which is based on an essentially all-inclusive feedback loop. The input is a reference light flash to the photomultiplier tubes, and the output for adjustment of the gain is taken from the digitalized resultant pulse amplitude within the analyzer. The system operates independent of the particular gamma spectrum under investigation, yet contributes no background of its own. Preliminary results suggest that stability of about 0.1 percent can be expected over one day, and it is hoped that this time can be considerably extended. (auth)

7458 CONTINUING USE OF THE WHOLE BODY COUNTER—THE NATURE OF THE PROBLEMS. Saenger, Eugene L.; Kereiakes, James G. (Univ. of Cincinnati). pp 450-58 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Cost factors of whole-body counters are discussed. Data are reviewed on the use of whole-body counters for clinical

isotope tests, for kinetic metabolic studies, and for studies of the metabolism of certain fission products, personnel monitoring, and in the event of nuclear accidents. Data are presented that show a reduction of radiation dose of 10 to 200% in patients when whole-body counters are used in clinical tracer studies as compared with external counting methods for point sources or radiographic examinations. The importance of radiation dose reduction in children is stressed. It is concluded that the cost of one whole-body counter is justifiable in a hospital for use in special clinical studies where dose reduction is important. It is pointed out that the use of whole-body counters in research has been established. The use of whole-body counters in the medical centers of large communities in investigations of fallout contamination and fission product contamination in the event of nuclear accidents is suggested. By locating counters throughout the country, data would be amassed on the many geographical, meteorological, climatological, and other ecological variations in fallout deposition and the effects of these factors on the uptake of radionuclides by humans. (C.H.)

7459 ON THE QUANTITATIVE AND QUALITATIVE DETECTION OF NEUTRONS USING SEMICONDUCTOR BODIES AND METHOD FOR THEIR PREPARATION. Guenther, Paul; Koehl, Guenter; Schneider, Wilhelm (to Licentia Patent-Verwaltungs-GmbH). German Patent 1,202,909. Oct. 14, 1965. Filed Apr. 5, 1956.

The semiconductor of silicon or germanium consists of an n-type body, which is provided with a p-type surface layer by doping with Al. The p-type surface layer is preferentially doped additionally with boron. (Gmelin Inst.)

Radiation Effects

7460 EFFECTS OF SINGLE NEUTRON-INDUCED DISPLACEMENT CLUSTERS IN SPECIAL SILICON DIODES. Gereth, R. (ITT Semiconductors, Palo Alto, Calif.); Haitz, R. H.; Smits, F. M. J. Appl. Phys., 36: 3884-94(Dec. 1965).

Radiation damage in uniform silicon avalanche diodes having an active volume of 10^{-11} cm^3 was investigated. Radiation-induced centers contribute to the carrier generation within the diode breakdown region, causing a corresponding increase in the avalanche pulse rate of the diode. The high sensitivity and the small volume of the diodes allow the study of permanent radiation damage resulting from single primary neutron collisions. By measuring the distribution function of the pulse rate on a statistical lot of diodes, a relationship between the pulse rate and the energy dissipated in atomic processes is derived. A superlinear increase of pulse rate with energy is observed. In general the higher pulse rates have a temperature dependence characterized by a lower activation energy than is the case for the lower pulse rates. For comparison, the effect of 2-Mev electron irradiation was studied. The pulse rate is found to increase linearly with integrated flux. At low fluxes the pulse rate is dominated by generation centers only, while in heavily irradiated diodes trapping effects become observable. Also at low fluxes the observed activation energy for carrier generation is 0.66 ev, while at higher fluxes this activation energy is lower by as much as 0.3 ev. The dependence of the observed activation energy on the flux in the electron case and the generally lower activation energies for the higher pulse rates in the neutron case is attributed to a tunneling interaction between individual defects. The defects in the larger neutron displacement damage clusters will have a wider spread in energy levels than those in the smaller clusters. This, in connection with the interaction between the individual defects, results in a reduced activation energy and an increased pulse rate. (auth)

7461 THE EFFECT OF HIGH-ENERGY PROTONS ON SEMICONDUCTOR DETECTORS OF NUCLEAR RADIATION. II. DIFFUSION-DRIFT DETECTORS. Brykina, L. S.; Vasilev, V. S.; Golovin, B. M.; Landsman, A. P.; Osipenko, B. P.; Fedoseeva, O. P. Kosm. Issled., 3: 499-502(May-June 1965). (In Russian).

Eighteen silicon n-i-p detectors with 0.3-mm sensitive films and four with 2-mm layers were subjected to proton bombardment of 2×10^9 to 8×10^9 protons/cm^2-sec with a maximum dose of 5×10^{13} protons/cm^2. With the 0.3-mm type, investigation was made of detector output pulse height, reverse current, energy resolution, and detector capacitance as a function of the radiation dose. The results show that the immunity of the diffusion-drift detectors is approximately equal to that of the surface-barrier type; i.e., no substantial deterioration of parameters was observed for doses as high as 10^{12} protons/cm^2. With the 2-mm type, the changes in the electrical structure were determined by measuring the detector photoresponse before and after bombardment. It was found that after a dose of 8×10^{12} protons/cm^2 the sensitive area of the detector was reduced, becoming practically negligible after a dose of 5×10^{13} protons/cm^2. (ATD)

7462 FAST NEUTRON BOMBARDMENT OF A LITHIUM-DRIFTED GERMANIUM GAMMA-RAY DETECTOR. Chasman, C.; Jones, K. W.; Ristinen, R. A. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods, 37: 1-8(Nov. 1965). (BNL-9157).

Pulse height spectra from a lithium-drifted germanium gamma-ray detector bombarded with monoenergetic neutrons are measured at neutron energies of 1.2, 2.2, 4.7, and 16.3 Mev. Gamma rays from inelastic neutron scattering in the counter and the counter cryostat are identified. An EO conversion electron line from the decay of the 691-kev first excited state in ^{72}Ge is very prominent, and at neutron energies of 4.7 and 16.3 Mev charged particle groups from neutron-induced reactions in the germanium appear. A discussion of the application of germanium gamma detectors to the study of (n,n'γ) reactions is presented. The detector is irradiated with a total fast neutron flux of approximately 10^{11} neutrons/cm^2 and shows no deterioration of resolution. (auth)

7463 SURFACE STATE DENSITY VARIATIONS ON MOS STRUCTURES DUE TO GAMMA RADIATION. Mattauch, R. J.; Lade, R. W. (North Carolina State of the Univ. of North Carolina, Raleigh). Proc. IEEE (Inst. Elec. Electron. Eng.), 53: 1748(Nov. 1965).

Metal-oxide-semiconductor capacitors were fabricated on p-type silicon with a 4300-Å thermally grown oxide. Metal electrodes were deposited by vacuum evaporation of aluminum through a metal mask. Curves are presented of surface state density as a function of surface potential for increasing values of gamma irradiation. (L.B.S.)

7464 NEUTRON INDUCED DISPLACEMENT DAMAGE IN INTEGRATED CIRCUITS. McElroy, J. A.; Boornard, A.; Gandolfo, D. A. (RCA Applied Research Labs., Camden, N. J.). Proc. IEEE (Inst. Elec. Electron. Eng.), 53: 1773-4(Nov. 1965).

Results are given for a reactor neutron irradiation of silicon monolithic integrated circuits and for individual n-p-n planar transistors of the type used in the circuits. Transistor, minority-carrier lifetime, and circuit damage coefficients were obtained. It is concluded that the circuit characteristics can be predicted from the behavior of the transistors alone, when the dominant effect of neutron irradiation is reduction of minority carrier lifetime. (L.B.S.)

7465 ELECTRON INDUCED SURFACE DAMAGE IN SILICON TRANSISTORS. Brucker, G. J.; Dennehy, W.; Holmes-Siedle, A. G. (David Sarnoff Labs., Princeton, N. J.). Proc. IEEE (Inst. Elec. Electron. Eng.), 53: 1800 (Nov. 1965).

Silicon planar transistors were bombarded with 125 kev and 1 Mev electrons. The base and collector currents were studied as a function of emitter to base voltage. Measurements were also made of the common-emitter gain. The results are presented and briefly discussed. (L.B.S.)

ISOTOPE TECHNOLOGY

General

Refer also to abstract 7020.

7466 (ORNL-TM-1356) SELECTED ABSTRACTS OF NON-U. S. LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES. Gerrard, Martha; Baker, P. S.; Lafferty, Robert H. Jr. (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 30p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Two hundred references on production and uses of radioisotopes and radiation are given to foreign journals, patents, and reports published from 1962 through June 1965. The references were selected from the July–Sept. 1965 issues of NSA. (P.C.H.)

Industrial Applications

Refer also to abstract 7600.

7467 (NP-15658) STUDIES OF BEEF IRRADIATION FLAVOR USING A CONCURRENT RADIATION-DISTILLATION TECHNIQUE. Wick, E. L. (Massachusetts Inst. of Tech., Cambridge. Div. of Sponsored Research). Dec. 1965. Contract DA19-129-AMC-99(N). 46p. (FD-32). CFSTI $2.00 cy, $0.50 mn.

Progress in the identification of beef components indispensable to the production of irradiation off-flavor is described. Evidence is presented that methional, n-nonanal, and phenylacetaldehyde are the major indispensable components. (auth)

7468 APPLICATION OF REPLICA PLATING AND COMPUTER ANALYSIS FOR RAPID IDENTIFICATION OF BACTERIA IN SOME FOODS. I. IDENTIFICATION SCHEME. Corlett, D. A. Jr.; Lee, J. S.; Sinnhuber, R. O. (Oregon State Univ., Corvallis). Appl. Microbiol., 13: 808-17(Sept. 1965).

A method was devised and tested for a quantitative identification of microbial flora in foods. This system was used to analyze the microbial flora in dover sole (Microstomus pacificus) before and after γ irradiation. (BBB)

7469 A REVIEW OF THE APPLICATIONS OF GAMMA-RAY RADIOGRAPHY IN JAPAN. Radioisotopes (Tokyo), 14: 65-71(Jan. 1965). (In Japanese).

The state of applications of γ-ray radiography in Japan was investigated by Expert Committee on Radiography. Inquiries were made to 788 enterprises and research establishments. The answers to the questionnaire, which were received by Jan. 16, 1964, are summarized. The questionnaire also included the gamma sources desired, their plans for the development of the radiography, etc. (NSA of Japan)

7470 STUDIES ON THE EFFECT OF MEDIUM DOSES OF GAMMA RADIATION ON THE ANTHOCYANIN PIGMENTS OF SOME FRUITS. I. PRELIMINARY INVESTIGATION ON THE SELECTION OF THE MOST SUITABLE PASTEURIZING DOSES FOR FRUITS, PULP, AND JUICES. Horubala, Adolf (Agricultural Univ., Warsaw). Rocz. Technol. Chem. Zywnosci, 10: 101-16(1964). (In Polish).

Fruit pasteurization studies were conducted with a 4000 C ^{60}Co source giving a dose rate of about 3×10^5 R/hr. Irradiation was carried out at 5 to 8°C to give doses of 150, 250, 350, 500, and 700 krad. Both agar and broth cultures were made of microorganisms remaining on the fruit after various doses. These investigations were carried out to determine optimal doses of radiation for extension of storage life of strawberries, raspberries, black currants, red currants, blueberries, and sour cherries as well as their juices. The decimal reduction value (D) of the population of microorganisms was found to be of the order of 110 to 120 krad. The most suitable doses of radiation (2D to 3D) for berries and fruits were 240 to 360 krad but doses for juices were about 120 krad higher. The rate of destruction of microorganisms was independent of the irradiated material (different berries, intact or as juices). Anthocyanin pigments were affected to a higher degree in juices than in whole berries. The color of strawberries and red currants was changed to a marked extent and the amount of anthocyanin pigment destroyed was highest in black currants and blueberries. It was concluded that about 90% of the microorganisms on these fruit varieties can be killed by moderate doses (about 100 krad), while 99.99% can be abolished by 5-fold higher doses (about 500 krad), although this destroys about half of the anthocyanin, thus impairing their natural color. (BBB)

7471 STUDIES ON THE EFFECT OF MEDIUM DOSES OF GAMMA RADIATION ON THE ANTHOCYANIN PIGMENTS OF SOME FRUITS. II. THE INFLUENCE OF GAMMA RADIATION ON ANTHOCYANINS IN DIFFERENT STATE OF PURIFICATION. Horubala, Adolf (Agricultural Univ., Warsaw). Rocz. Technol. Chem. Zywnosci, 10: 117-30(1964). (In Polish).

Methods are described for separating the anthocyanin pigments from various fruits. Preliminary extraction with phosphate buffer was carried out, followed by acid-alcohol precipitation, and purification by column chromatography. Irradiation of various fractions was conducted with ^{60}Co, at a dose rate of 3×10^5 R/hr, to doses of 100 to 500 krad at 5-8°C. Destruction of the pigments was followed by optical density measurements at 430 and 258 mμ. The results showed that sensitivity to γ radiation of anthocyanin pigments isolated from strawberries, raspberries, black currants, red currants, blueberries, and sour cherries increased with progressive purification. After cellulose column chromatography separation and dissolution in phosphate-citrate buffer (pH 3.0), anthocyanins from sour cherries and red currants showed a relatively higher sensitivity to γ irradiation than anthocyanins from black currants and blueberries. The amount of protective agents for anthocyanins was highest in raspberry juices and least in red currant. The anthocyanin derivative cyanidin was more sensitive than delfinidin and particularly than pelargonidin. Cyanidin showed about 30% higher sensitivity to irradiation than its corresponding glycoside, and a similar relation was observed between quercetin and rutin. In general, a linear relation was noted between irradiation dose and destruction of anthocyanin pigments (as measured by optical density decreases) in the range 50 to 300 krad. (BBB)

7472 EFFECT OF IONIZING RADIATION ON THE MICROFLORA OF WHEAT. Jakubczyk, T.; Zarnowiecka, N. (Warsaw Agricultural Univ.). Zesz. Nauk Szkoly Glownej Gosp. Wiejsk. Warszawie, Technol. Rolno-Spozywcza, No. 3, 137-48(1964). (In Polish).

The effect of γ irradiation on the microörganisms associated with wheat containing 16 to 20% of moisture was investigated. Irradiation was carried out in the WWR-S reactor with doses of 7 to 2400 krad. The irradiated grain was then stored for 120 days at 20°C, and the microbial content investigated. A distinct decrease of microörganisms even with a dose of 10^5 rad was observed. There was no significant influence of moisture content of the grain on the effect of irradiation on the microflora. The effect of irradiation increased with the dose applied. Molds and bacteria showed similar resistance to irradiation. Irradiation at a dose of 140 krad retarded the development of microörganisms even in the grain containing 20% moisture. In grain containing 16% moisture this effect could be obtained with lower doses. (BBB)

7473 THE EFFECT OF GAMMA IRRADIATION ON SOME TECHNOLOGICAL PROPERTIES OF WHEAT. Jakubczyk, T.; Zarnowiecka, N.; Haber, T. (Warsaw Agricultural Univ.). Zesz. Nauk Szkoly Glownej Gosp.

Wiejsk. Warszawie, Technol. Rolno-Spozywcza, No. 3, 149-60(1964). (In Polish).

The WWR-S reactor was used to investigate the effect of 7 to 2400 krad doses of γ irradiation on some technological properties of wheat containing 16 and 20% moisture. Doses above 47 krad caused the darkening of flour, especially with the wheat of the higher moisture content. Medium doses (up to 430 krad) improved the baking qualities of flour (higher volume, better porosity), while the dose of 2400 krad caused the destruction of gluten and gave the bread of very poor quality. No effect on amylase was observed. (BBB)

7474 DEGRADATION OF PECTINIC ACID BY IONIZING RADIATIONS AND BY PECTIC ENZYMES [Thesis]. Deshpande, Shreekant Nageshrao. Lafayette, Ind., Purdue Univ., 1965. 154p.

The degradative processes in pectic constituents resulting from radiation and activity of the natural enzymes as combined factors were studied. With waste fuel elements and cobalt-60 as sources of radiation, solutions of pectinic acid were exposed to four doses of gamma radiation ranging from 4×10^3 to 1×10^4 rads. Solutions of pectinic acid were treated with pectin methylesterase and pectase and irradiated as before to determine if previous enzyme action accelerated the breakdown process. In order to determine if, in contrast, pectins were predisposed to enzyme action by previous radiation exposure, the sequence of radiation was reversed. Pectinic acid solutions were treated with calcium salts and irradiated to determine if gels formed by inorganic salts could afford protection against radiation damage, analogous to sugar acid gels. The extent of depolymerization was determined by estimation of the molecular weights and reducing value of the end groups. Total uronide content and alkoxyl content were also determined. Depolymerization due to radiation was found to be linear with dose rates in case of waste fuel elements. The depolymerization was extensive with cobalt-60 as a source of radiation. Higher ester content did not increase depolymerization. Demethylation probably had a protective action through molecular aggregation. Inorganic salts seemed to exercise a protective action through ionic bonding. Action of enzymes after the irradiation treatment seemed to be more damaging, as indicated by diminishing molecular weights, than irradiation after enzyme action. These results indicate that inactivation of enzymes before irradiation and use of firming agents such as calcium chloride, could minimize degradation of pectic constituents. (Dissertation Abstr.)

7475 THE ROLE OF FREE AND BOUND WATER IN IRRADIATION PRESERVATION: RADIOLYSIS AS A FUNCTION OF THE PHYSICAL STATE OF WATER [Thesis]. Wedemeyer, Gary Alvin. Seattle, Wash., Univ. of Washington, 1965. 167p.

The equation $D_c = D_0/(1 + (\alpha/c))$ was used to relate the amounts of bound and free water in fish muscle tissue to the radiolysis of tissue -SH groups. G, D_{37}, and "target size" values were measured in a water-cellulose-ascorbate model system. These variables were a direct function of both the amount of bound water present during irradiation and the physical state of the ascorbate. The results from both the intact tissue and the model systems indicated that substantially all the radiation damage occurring in irradiation-pasteurized fish muscle involves one or more of the forms of tissue water. Bound water mediates radiolysis primarily through energy transfer while free water acts as a source of free radicals and peroxides. Substantial protection from radiolysis occurred only when all of the free and about half of the bound water had been removed from the tissue. It was also shown that protection from radiolysis can occur when the physical location of cellular free water is altered by a sufficiently slow rate of freezing. Evidently small molecules can diffuse through the plasma membrane when the tissue is frozen slowly. The effect of freezing rate on the radiosensitivity of bacterial cells was found to be too small to be of any practical significance. Studies were designed to determine whether pasteurizing doses of ionizing radiation could induce membrane permeability changes in fish muscle tissue and bacterial cells or spores, allowing the diffusion of intracellular substances into the free water of the tissue. Finally, it was shown that the free water of fish muscle tissue is involved in radiation damage through reactions occurring in the vapor phase. (A.G.W.)

7476 RADIONUCLIDES IN RADIATION PROCESSED FOODS. Weiland, Raymond L.; Hankla, Robert H.; Meneely, E. U.; Meneely, George R. (Vanderbilt Univ., Nashville). pp 37-47 of Radioactivity in Man. George R. Meneely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.

Gamma ray analysis of radiation processed canned pork was carried out to investigate the possibility of radionuclides induced during processing. The canned pork was radiated by ^{60}Co γ rays, spent reactor fuel rods, or electron beams of 8 to 24 Mev energy and about 5 megarad doses. Samples of 15 No. 10 cans or 85 No. 2 cans, providing a 90-lb sample, were counted in a whole-body counter. Irradiation energies below approximately 12 Mev did not alter the radioactivity of the meat from that before irradiation. At 16 Mev with a dose of 5.6 megarad, the activity of a 90 lb sample was equivalent to about 0.7 μ gm of ^{226}Ra at 130 hr after irradiation. (C.H.)

Separation and Production

See also CHEMISTRY — Separation Processes and Procedures

7477 FOCAL PROPERTIES OF ISOTOPE SEPARATORS USING AZIMUTHALLY INVARIANT MAGNETIC FIELDS. Whitehead, T. W. Jr. (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 36: 3693-6(Dec. 1965). (ORNL-P-1200).

The ion optical properties of an azimuthally invariant magnetic field which are important in the electromagnetic separation of isotopes are considered. The solutions are limited to the case in which the object and image are within the field. A method based on the principle of least action is used to find general expressions for the values of the coefficients in the field expansion that will produce midplane focus at any angle. The three-dimensional motion of ions is considered with regard to isotope separations, and the general focal properties of inhomogeneous magnetic fields that satisfy the midplane image requirements are described. (auth)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 7951 and 8066.

7478 (AECL–2508) A PROGRAM TO RELOCATE AND PACK PROGRAMS IN BINARY FORMAT. Bowman, J. W. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov. 1965. 13p. Dep.; AECL $0.50.

A relocation package was written to provide a means to shuffle machine language programs around in memory to make the most efficient use of computer store. This report describes this relocation program, the format required to make it possible and the operation of the program itself. The program is now in use and has proved to be a most effective tool, both in assembling a combination of existing programs, and in amending and fault-finding new programs. (auth)

7479 (IS–1279) SDS 910 IMPLEMENTATION OF THE TASK 65 REAL TIME PROGRAMMING LANGUAGE. Fitzwater, D. R.; McFarland, D. E.; Runge, C. E. (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 45p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

A specific hardware implementation of the TASK 65 programming language in a real time multiprogramming computer system is described. Hardware dependent features of the language are defined for this implementation. (auth)

7480 (IS–1280) TASK 65. A CONSEQUENT PROCEDURE REAL TIME COMPUTER LANGUAGE. Fitzwater, D. R.; McFarland, D. E. (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 68p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A complete description of a real-time multiprogramming computer language is given in the fashion of the ALGOL 60 report. Consequent procedures are defined by the consequences of previous (in time) procedures rather than by the programmer. The use of these concepts leads to a comparatively simple system and a very powerful real-time programming language. The language is developed with ALGOL 60 as a base for modification. (auth)

7481 (LA–3386) ON THE CONVERGENCE OF DISCRETE APPROXIMATIONS TO SOLUTIONS OF MIXED BOUNDARY VALUE PROBLEMS. Wigley, Neil M. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Sept. 3, 1965. Contract W-7405-eng-36. 20p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Let D be a bounded, simply connected domain in the plane with piecewise smooth boundary Γ. Let Γ be composed of two parts, Γ^1 and Γ^2. Consider the problem of finding a function harmonic in D with prescribed values on Γ^1 and with prescribed values for the normal derivative on Γ^2. Let difference equations for a mesh of width h be set up, using the five-point Laplacian together with standard difference equations near the boundary. Let the corners of D be the points where the boundary is not smooth, together with the points common to both Γ^1 and Γ^2. Then in any subdomain which does not contain the corners, the error is of the order of h. The results apply even if the harmonic function in question has derivatives which are singular at the corners. (auth)

7482 (SC–DC–65–1898) QUATERNIONS AND ROTATIONS. Morrison, D. R.; Carstens, A. M. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1965. Contract AT(29-1)-789. 10p. Dep. mn; CFSTI $1.00 cy, $0.80 mn.

Some relations between 3 × 3 orthogonal matrices having positive determinants (rotation matrices) and quaternions are found. In particular, a correspondence is shown to exist between rotation-matrix products and quaternion products. The correspondence allows simplification of several matrix operations. The correspondence is not one-to-one, is not restricted to quaternions of unit room, and involves only rational operations. (T.F.H.)

7483 (SC–RR–65–502) STATUS REPORT ON MAGNETICS TECHNOLOGY IN ADVANCED DATA SYSTEMS. Szymanski, J. B. (Sandia Corp., Albuquerque, N. Mex.). Nov. 1965. Contract AT(29-1)-789. 186p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

Systems, techniques, and components for magnetic data handling, magnetic logic operations, and magnetic analog and digital storage are surveyed. 74 references. (T.F.H.)

7484 (ZFK-TPH–14) NEUE ZUFALLSZAHLEN-GENERATOREN FUER DEN SRA-1. (New Random Number Generator for the ZRA-1). Boettger, Horst (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). Dec. 1964. 34p. Dep. mn.

In addition to the specification of the most important properties of equally distributed random number generators and the possibilities of their representation on digital computers, the peculiarities of the ZRA-1 were taken into consideration. It was shown on the basis of examples that not every random algorithm is usable for the ZRA-1. A detailed description of a new method of random number production on the ZRA-1 and its characteristics, advantages, and applications is given. Two representations from a group of generators are given as ZRA-1 code. After a brief summary of the most important test methods for random numbers, a description of the tests carried out for the generators is reported. The most important test results are tabulated. (tr-auth)

7485 ANALYSIS OF ELECTRICAL NETWORKS WITH THE AID OF THE DIGITAL COMPUTER ZRA 1. Tamme, J. (VEB Atomkraftwerk, Berlin). Kernenergie, 8: 502 (Aug. 1965). (In German).

A program system was formulated that transfers the logical functions that describe, for example, an electrical network automatically into a disjunctive normal form. The program is briefly described and the advantages of its utilization are indicated. (J.S.R.)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 7779, 7780, 8316, 8390, and 8394.

7486 (AERE-M-1489) INVESTIGATION OF ^{14}C LABELLED GRAPHITE BY AUTORADIOGRAPHY. Hughes, J. D. H.; McCabe, W. J. (Research Group, United Kingdom Atomic Energy Authority, Wantage (England)). Dec. 1964. 17p. Dep. mn.

Graphite labeled with ^{14}C by the $^{14}CO/C$ reaction was prepared for in-pile experiments, and examined autoradiographically for homogeneity by exposing in contact with x-ray film. The main difficulty encountered when preparing specimens was in the thinning technique. There is no advantage in thinning specimens unless the final thickness is less than the range of ^{14}C β particles in graphite; about 10 μ. Additionally, the porous nature of graphite presents a specimen which is nonuniform in density and therefore in self absorption, and whose autoradiographs are consequently difficult to interpret. Detail down to a resolution of about 2 μ was obtained. (P.C.H.)

7487 (BAW-291) ETCHANT DEVELOPMENT FOR THORIA FUELS. Final Report. Halva, C. J.; Dodd, R. H.; Dewell, E. H. (Babcock and Wilcox Co., Lynchburg, Va.). Oct. 1965. Contract AT(30-1)-3376. 12p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Studies were made on etchants that could be used to bring out the crystal boundaries of thoria-urania polycrystalline materials in sufficient detail for photomicrographic study. The etchants tested were mineral acids and mixtures of HF and H_3PO_4, HF and HNO_3, and $H_2SO_4-H_2O_2$. A procedure is recommended that consists of abrasive polishing steps followed by a high-temperature etch with H_3PO_4 that contains catalytic quantities of fluoride. (P.C.H.)

7488 (BMI-1742(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING AUGUST 1965. Dayton, Russell W.; Paprocki, Stan J. (Battelle Memorial Inst., Columbus, Ohio). Sept. 1, 1965. Contract W-7405-eng-92. 34p. Dep. mn; CFSTI $0.75 cy, $0.50 mn.

Progress in the research and development programs on reactor materials and components, ceramic fuels, radioisotope and radiation applications, coated-particle fuel materials, and gas-cooled reactors is reported. (W.L.G.)

7489 (BMI-1745) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING SEPTEMBER 1965. Dayton, Russell W.; Paprocki, Stan J. (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1965. Contract W-7405-eng-92. 31p. Dep. mn; CFSTI $0.75 cy, $0.50 mn.

Separate abstracts were prepared for the 5 sections of the report. (W.L.G.)

For abstracts of individual sections see: 7125, 7490–7492, and 7627.

7490 (BMI-1745, Sect. A) REACTOR MATERIALS AND COMPONENTS. Hodge, E. S. (Battelle Memorial Inst., Columbus, Ohio). 10p.

Progress in studies on the effect of irradiation on the mechanical properties of type 347 stainless steel, interstitial behavior in Cr–Re type alloys, densification of graphite by unconventional fabrication techniques, examination of the 1B Steam Generator from the PWR, fretting characteristics of spacer-clip materials for Zircaloy-4-clad fuel elements in 550°F water, feasibility of sizing large chevron components by hydraulic methods, development of techniques for explosively sizing 15 in. dia welded Zircaloy-4 preforms, and explosively welding duplex aluminum–Zircaloy-4 tubing is reported. (W.L.G.)

7491 (BMI-1745, Sect. B) STUDIES OF FUELS. Keller, D. L. (Battelle Memorial Inst., Columbus, Ohio). 6p.

Progress in studies on (Pu,U)N fuels, development of $BeO-PuO_2-ThO_2$ fuels, effects of high burnup on CeO_2-UO_2 and UO_2-ZrO_2 fuels, and development of fuel plates for the AARR is reported. (W.L.G.)

7492 (BMI-1745, Sect. L) COATED-PARTICLE FUEL MATERIALS. Townley, C. W.; Cunningham, G. W.; Miller, N. E. (Battelle Memorial Inst., Columbus, Ohio). 7p.

Progress in studies on fuel particles, coated-particle preparation and characterization, compatibility of carbon-coated uranium nitride, and postirradiation properties of coated fuel particles is reported. (W.L.G.)

7493 (BMI-1748(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING OCTOBER 1965. Dayton, Russell W.; Paprocki, Stan J. (Battelle Memorial Inst., Columbus, Ohio). Nov. 1, 1965. Contract W-7405-eng-92. 26p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Progress in studies on reactor materials and components, fuels, PuN–UN fuel materials, radioisotope and radiation applications, coated-particle fuel materials, and corrosion in the fluidized-bed fluoride-volatility process is reported. (W.L.G.)

7494 (BNL-953) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review, Volume 3, Number 4, August 1965. (Brookhaven National Lab., Upton, N. Y.). Nov. 1965. Contract AT-30-2-GEN-16. 52p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

Twenty-one reviews of current topical and progress reports on research and development programs concerned with liquid metals are presented. Subjects covered include: fluid dynamics, heat transfer, material development, corrosion, instrumentation, chemistry, chemical analysis, and component development. (W.L.G.)

7495 (BNWL-150) CERAMICS RESEARCH AND DEVELOPMENT QUARTERLY REPORT, APRIL–JUNE 1965. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Contract AT(45-1)-1830. 130p. Dep. mn; CFSTI $4.00 cy, $1.00 mn.

Separate abstracts were prepared for the 5 sections in the report. (W.L.G.)

For abstracts of individual sections see: 7496, 7497, 7531, 7532, and 7629.

7496 (BNWL-150, pp 1,1-28) CERAMIC FUEL RESEARCH STUDIES. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

An electric potential gradient applied to UO_2 at 1600°C resulted in the migration of O_2, and decomposition of the UO_2. The O_2 dissociation pressure of $AmO_{1.91}$ ranges from 10^{-6} atm at 1190°K to 10^{-3} atm at 1400°K. Equilibrium is attained slowly at O_2 pressures less than 10^{-5} atm, with as long as 5 days being required at 1190°K. Plots of log P_{O_2} vs T^{-1} are linear and yield a compositional dependence for the partial molar enthalpy of solution of O_2 in AmO_{2-x}. These values range from –120 kcal/mole at $AmO_{1.98}$ to –96 kcal/mole at $AmO_{1.96}$. The thermal diffusivities of UO_2 and US were measured between 25 and 1400°C. Preliminary measurements were made of the high temperature electrical resistivity of near stoichiometric single crystal UO_2. Reproducible results were obtained when the measurements were conducted in a reducing atmosphere of Ar – 8 wt. % H_2. PuN was densified to 91 to 99% of theoretical by pneumatic impaction at ~1200°C. (W.L.G.)

7497 (BNWL-150, pp 3,1-30) PRTR FUEL ELEMENT PERFORMANCE AND FABRICATION. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Photomicrographs and autoradiographs of UO_2 – 2 wt. % PuO_2 PRTR HPD fuel elements operated with a molten core during irradiation are given with a description of the per-

tinent phenomena observed during the examination of the rods. The fabrication features and results of temperature measurements during irradiation of a thermocoupled HPD fuel element are presented. The effects of water vapor and the type of end closure on the hydride formation in Zircaloy-2 test capsules were measured. The corrosive attack was limited to the end cap crevice region and occurred when the moisture content was at or below 600 ppm at 320°C. The swageable type end cap was superior to the vibration compaction type in resisting hydride formation. A mechanism of crevice corrosion is proposed. The increase power generation and exposure goals set for the batch core and molten core experiments in PRTR required changes in the fuel element design. Postirradiation examination of salt cycle fuel irradiated in the MTR indicates satisfactory performance despite high chloride contamination. The variable costs of fabricating plutonium fuel rods were determined. (W.L.G.)

7498 (BNWL-SA-415) STAINLESS STEEL-PuO_2 CERMET DEVELOPMENT STUDIES. Goldsmith, S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 14, 1965. Contract AT(45-1)-1830. 6p. (CONF-651119-5). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Libby Cockcroft Information Exchange Meeting, Harwell, Eng.

The methods of fabrication and postirradiation examinations of cermets of stainless steel and 20 vol % PuO_2, 20 vol % Pu_2O_3, or 30 vol % UO_2 are described. (W.L.G.)

7499 (GEMP-53A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 53, PART A. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Nov. 26, 1965. Contract AT(40-1)-2847. 83p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Four Fe-Cr-Al-Y-clad fueled specimens completed 10,000 hrs of testing at 950°C in air. Uranium was detected on the surface of the specimens after 8000 hrs. The in-pile test (LTFC-2) of a Fe-15Cr-4Al-1Y-clad Fe-UO_2 specimen was completed; it had accumulated 2000 hrs at 950°C in flowing air. Fractional release of fission gases remained low throughout the test. Examination of a series of Fe-Cr-Al-Y alloys after testing in air for 10,000 hrs at 450 to 1100°C revealed that the Fe-25Cr-4Al-1Y and Fe-15Cr-4Al-1Y alloys have nearly identical oxidation resistance at all temperatures tested. The Fe-15Cr-4Al alloy (containing no Y) experienced oxide spalling and demonstrated generally poor oxidation resistance at 900 and 1100°C. Creep-rupture evaluations were performed at 1600, 2000, and 2400°C using six different sheets of powder metallurgy tungsten, four from the Naval Sheet Rolling Program and two from different commercial sources, and an arc-cast tungsten sheet from an Air Force program. The results at 1600°C were the most consistent, but even at this temperature, the time to rupture at 5.62 kg/mm^2 varied from 4.5 to 19.5 hrs. The larger variation at 2000 and 2400°C was attributed to considerable differences in the resultant microstructure of the sheets tested at these temperatures. Powder metallurgy and arc-cast W-25Re sheet, obtained from a number of vendors, was creep-rupture tested at 2000°C and 2.11 kg/mm^2 in hydrogen. Each sheet exhibited different creep curves, but when the data are plotted log-strain versus log-time, the creep curve shapes are similar for either the powder metallurgy material or arc-cast material, but not for both. The arc-cast material was three times as ductile as the powder metallurgy material based on elongation at rupture. The first-stage creep equation forms previously evaluated using data for Pb at 14.5°C and recent GE-NMPO data for arc-cast W at 2400°C were employed in an analysis of some published first-stage creep data for Ni at 700°C. In each case the degree of representation was found to be very good. Similarly, good results were obtained using data for Al, Pt, Ag, and Mo. Analyses were initiated to evaluate various expressions capable of describing the strain-time behavior for combined first- and second-stage creep data. The tensile strength for W-25Re-30Mo (at. %) was determined giving values of 130 kg/mm^2 at room temperature and 18 kg/mm^2 at 1600°C. Studies of thermocouple sheathing materials show Ta to be superior to W-5Re, W-25Re, W-30Re-30Mo, Mo, or Os for preventing degeneration of the emf signal as a function of time when exposed to carbonaceous environments at 2450°C. Seventeen W-Re-Mo alloys containing exceptionally low C and other impurities, were evaluated for bend ductility and hardness after holding for 2, 10, and 100 hrs at 1200, 1600, 2000, and 2400°C. Alloys with 30% Mo retained good ductility after holding at 1200°C. Comparisons with alloys containing more impurities indicate that C promotes sigma phase precipitation. Sigma phase in alloys with high C content dissolves readily at high temperature; i.e., C does not stabilize sigma phase. However, C and other impurities, when present in sufficient amounts, are believed to prevent grain growth in the alloys. Mo-W-Re alloys with 25% Re were evaluated. Alloys of Mo-15W-25Re and Mo-30W-25Re retained high ductility in room temperature bends after holding for 100 hrs at 1200, 1600, 2000, and 2400°C. One alloy (Mo-30W-30Re) is being investigated for high strength requirements in the 1200°C range; tests to date indicate that this alloy undergoes age-hardening reactions in that temperature range. Improved weldability and weld-ductility were obtained in unalloyed Mo treated for long times in hydrogen-water vapor atmospheres. Pore-free welds were not obtained, however, apparently due to high oxygen content in the treated metal. (W.L.G.)

7500 (ORNL-TM-1335) MACHINE-ASSEMBLED REVIEWS ON COATED NUCLEAR FUEL PARTICLES. Pilloton, R. L. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 80p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A computer-produced selection of approximately 425 reviews of recent reports, articles, and patents on coated nuclear fuel particles is presented. The 50- to 150-word summaries were prepared by the Nuclear Fuel Technology Information Center and extracted from a general magnetic tape file by a computer program based on reference codes and keywords. Specific information on the preparation, evaluation, applications, and economics of coated-particle fuels is given along with general information on processes widely used in the field such as fluidization. Subject and author indexes are included. (P.C.H.)

7501 (TID-22426) BATTELLE-NORTHWEST STUDIES EXECUTED FOR THE USAEC-AECL COOPERATIVE PROGRAM. Monthly Progress Report, November 1965. Albaugh, F. W. (comp.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 6, 1965. Contract AT(45-1)-1830. 7p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Developments are reported for studies on: cross-flow mixing between parallel flow channels during boiling; parallel channel reactor boiling stability; in-reactor measurements of creep in Zr-2.5 Nb alloy; Zr-Nb pressure tubing; and in-reactor corrosion evaluation of zirconium alloys. (P.C.H.)

7502 (UCRL-16393) SIMULTANEOUS THREE-ELEMENT CONDENSATION. Kennedy, Kurt (Lawrence Radiation Lab., Univ. of California, Berkeley). Sept. 1965. Contract W-7405-eng-48. 14p. (CONF-650957-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From American Inst. of Metallurgical Engineers, San Francisco.

A method is described by which three elements can be condensed simultaneously on a common substrate in such a way that the composition varies with position on the substrate. Almost all possible combinations of three solid elements can be formed in a single evaporation. The three elements are heated by magnetically deflected electron beams. The alloys and compounds formed by this method generally correspond to those made by other methods; however, many exceptions exist. Simple symmetric crystallographic phases tend to form in preference to more complex phases. The Nb-Sn, Cr-Fe-Ni, Mn-Ca, and other systems of alloys made by this method are discussed. Phases that form very slowly, such as the sigma phase in Cr-Fe alloys, may be formed rapidly by this method when certain substrate temperatures are used. (auth)

7503 METALS FOR THE SPACE AGE. Higgins, G. T. (Univ. of Liverpool). Discovery, 26: 40-4(Aug. 1965).

Scientific and technological advances in the use of such metals as beryllium, titanium, and zirconium in the nuclear and space fields are reviewed. In addition to its neutron moderating properties, beryllium has low density coupled with good strength and exceptional rigidity. The importance of Zr in nuclear reactors, like that of Be, depends on its low neutron capture cross section. Zirconium is a useful construction material in the cores of nuclear reactors. The importance of Ti stems from its relatively low density coupled with high strength and ductility, particularly at high temperatures. The problem of brittleness of Be can be partially overcome by the technique of powder metallurgy. As a moderator, Be metal is used in small reactors where large numbers of neutrons are present in a small volume. However, the oxide possesses greater potential for use in large reactors. The intrinsically low neutron capture cross sections of Zr was not evident originally because Zr usually contains two % hafnium, an element whose cross section is 640 times that of Zr. Methods were developed for eliminating Hf during Zr manufacture. Economic aspects of the three metals are discussed. (BBB)

7504 REMOVAL OF THIN (20 A) LAYERS OF METALS, METAL OXIDES, AND CERAMICS BY MECHANICAL POLISHING. Whitton, J. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Appl. Phys., 36: 3917-22(Dec. 1965).

The method of vibratory polishing was applied to the reproducible removal of thin layers from metals, oxides, and ceramics. The rate of removal depends on the hardness of the material being polished, and for the materials tested (W, Ta, Si, Zr, Au, UO_2, Ta_2O_5, and ZrO_2), is in the range of a few atom layers (20 to 50 Å) per minute of polishing time. Experimental details are described, and the results obtained are shown. Studies were made of the surfaces of these materials by x-ray diffraction, reflection electron diffraction, and electron microscopy to determine the effect of the polishing on crystal structure and surface topography. The results show that all the materials except gold have surfaces smooth to within 50 Å, that W and Ta single crystals have disturbed or deformed layers of less than 250 Å and that single-crystal Si is not deformed at all. (auth)

7505 PREPARATION OF TUNGSTEN METAL POWDER. Kantan, S. K.; Roghavan, R. V.; Rao, N. K. Trans. Indian Inst. Metals, 17: 191-5(Dec. 1964).

Tungsten trioxide powder is prepared by the acid decomposition of sodium tungstate, followed by washing, filtering, drying and finally heating in air at about 400°C. Tungsten metal powder is produced by the hydrogen reduction of the trioxide at about 550°C, and then at above 700°C. Fine oxide powder is obtained when acid and tungstate solution are maintained at low temperature (10°C), whereas coarse powder is obtained when the solutions are at relatively high temperatures (90°C). Increase of acid concentration, from 150 to 570% excess, results in a decrease in the particle size of tungsten powder and increase in the yield of trioxide from 87.24 to 98.26%. (Rev. Metal Lit.)

7506 DEFECTS AND FAILURES IN PRESSURE VESSELS AND PIPING. Thielsch, Helmut. New York, Reinhold Publishing Corp., 1965. 455p.

During the time the base metal is produced to the time the erected vessel or piping system is placed in use, a multitude of operations have been performed on it. Any one of these operations can result in a defective product if improperly performed. The conditions leading to failures are discussed and typical defects and failures, which apply to a few materials, are illustrated. The same causes and failure mechanisms apply to other materials, and the conditions applicable to another material can be interpreted from the examples given. (W.L.G.)

7507 CERAMICS FOR ADVANCED TECHNOLOGIES. Hove, J. E.; Riley, W. C. (eds.). University of California Engineering and Physical Sciences Extension Series. New York, John Wiley and Sons, Inc., 1965. 459p. $19.50.

The fabrication-microstructure-properties relationship for oxides, graphite, glasses, intermetallics, and composites are considered. Other topics covered include: refractory nuclear fuel element materials, aerospace nuclear propulsion technology, materials aspects of missile and satellite reentry, auxiliary space power devices, rocket nozzle technology, and the space environment and its effects. Separate abstracts were prepared for 10 of the 14 chapters. (M.C.G.)

For abstracts of individual chapters see: 7508–7513, 7528, 7649, 7782, and 8450.

7508 GRAPHITE. Riley, W. C. (Aerospace Corp., El Segundo, Calif.). pp 14-75 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

The properties of graphite, including high strength at elevated temperature, low density, high vaporization temperature, and good resistance to thermal shock, are discussed. Its lack of reducibility and uniformity of structure and properties, poor oxidation resistance, and brittle fracture are also considered. The properties of graphite in relation to its microstructure and how microstructure can be controlled by fabrication techniques and selection of raw materials are discussed. Topics covered include: effect of fabrication variables; graphite properties; reactor moderator and reflector properties; pyrolytic graphite; thermal properties of pyrolytic graphite; mechanical properties of pyrolytic graphite; oxidation and vaporization of pyrolytic graphite; residual stress in pyrolytic graphite, advanced applications for pyrolytic graphites; and other advanced graphites. (86 references.) (F.J.H.)

7509 OXIDE CERAMICS. Carnahan, R. D. (Aerospace Corp., El Segundo, Calif.); Knapp, W. J. pp 76-106 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

The stability and strength of oxide ceramics at elevated temperatures in the presence of oxygen are discussed. Some of the commonly used methods for fabricating oxides are reviewed. The effects of synthesis and fabrication variables on the characteristics of the product are considered. The effects of fabrication techniques on microstructure and the importance of defect structure in determining mechanical behavior are discussed. (51 references.) (F.J.H.)

7510 BERYLLIUM OXIDE. Rothman, A. J. (Univ. of California, Livermore). pp 107-42 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

Properties of beryllium oxide and their relation to microstructure and fabrication variables are discussed. The properties of beryllia are shown to fall into two categories, those fundamental to the crystal compound and those that are structure-sensitive and depend on method of forming, porosity, grain size, etc. The two primary methods used to fabricate dense BeO, sintering after cold-forming and hot-pressing, are described. Radiation damage in a fast neutron flux is described. (80 references.) (F.J.H.)

7511 INTERMETALLIC MATERIALS. CARBIDES, BORIDES, BERYLLIDES, NITRIDES, AND SILICIDES. Kendall, E. G. (Aerospace Corp., El Segundo, Calif.). pp 143-83 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

Intermetallic materials, such as carbides, borides, beryllides, nitrides, and silicides, for use at extremely high temperatures, are discussed. Data on the chemical, mechanical, and physical properties of these materials are reviewed. Current and potential synthesis and fabrication methods that may lead to materials of improved quality are considered. (91 references.) (F.J.H.)

7512 GLASS MATERIALS. Slaughter, J. I. (Aerospace Corp., El Segundo, Calif.). pp 218-50 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

Glass-forming compounds and theories of glass formation, the structure of glass, and some examples of the in-

fluence of the microscopic nature of glass on macroscopic properties are discussed. The glass surface and its influence on macroscopic properties, response of glass to radiation, some examples of the use of glass in aerospace vehicles, and development of glass and nonmetallic fibers are also considered. (33 references.) (F.J.H.)

7513 REFRACTORY NUCLEAR FUEL ELEMENT MATERIALS. Kendall, E. G.; Riley, W. C. (Aerospace Corp., El Segundo, Calif.). pp 251-85 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

The properties and behavior of ceramic materials, which might be used as fuel elements, are discussed. Ceramic fissile materials, coated fuel particles, and graphite as a typical fuel matrix material are considered. Uranium beryllides, uranium carbides, uranium nitrides, and uranium oxides are described. Fuel-graphite geometries, fuel element fabrication, effects of fuel loading and particle size on physical properties, radiation effects on fueled graphite, and fission-product release from fuel graphite are discussed. (49 references.) (F.J.H.)

Corrosion

Refer also to abstracts 7215 and 8429.

7514 (DC-60-4-179) COLUMBIUM FUEL ELEMENT DEVELOPMENT. Baranow, S.; Lever, R. C.; Tarr, C. O.; Wukusick, C. S. (General Electric Co., Cincinnati, Ohio. Aircraft Nuclear Propulsion Dept.). Apr. 29, 1960. Contract AT(11-1)-171. 112p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Attempts to coat Nb or Nb alloys by dipping specimens in molten solutions of Al-base alloys proved unsuccessful. The predominant mode of failure was by cracking of the outer protective layers. Tests on a wide variety of base metal, slip, and impregnating compositions indicated best performance was obtained when unalloyed Nb-base material was coated with Nb slip impregnated with a solution of Al-10 wt % Cr-3 wt % Si. One specimen remained oxidation resistant for a 900-hr period at 2500°F with 35 thermal cycles being applied between room and test temperatures. The factors controlling the life of the system are: diffusion of Nb out toward the surface, growth of voids in the coating due to diffusion of Nb outward, concentration of Nb in the coating near the surface of the specimen, and initial thickness of Al-Nb compounds. Specimen fabrication and proposed in-pile tests to demonstrate fission product retention by the Nb-base materials are discussed. (W.L.G.)

7515 (HW-61799) RUPTURE KINETICS OF ZIRCALOY-CLAD FUEL ELEMENTS IN HIGH TEMPERATURE WATER AND STEAM. Interim Report No. 3. MECHANISM OF THE URANIUM-WATER REACTION. Troutner, V. H. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). [nd]. Contract AT(45-1)-1350. 14p. CFSTI $1.00 cy.

Ten uncapped samples of coextruded Zircaloy-2-clad uranium core rod were exposed to water at temperatures from 200 to 300°C and pressures from 750 to 2250 psig. The resultant corrosion was found to be the sum of two forms of attack; uniform penetration and non-uniform pitting. The kinetics and mechanism of the attack are discussed. The highly directional nature of the hydriding attack suggests that it proceeds along some sort of path in the working direction, probably along stringers of impurities. (P.C.H.)

7516 (OTR-131) HIGH TEMPERATURE PROTECTIVE COATINGS FOR MOLYBDENUM AND TUNGSTEN. (Williams (Clyde) and Co., Columbus, Ohio). Nov. 1965. 26p. CFSTI Free.

Significant reports covering the period from 1960 were selected for this study with reference to earlier works. Recent government-sponsored research runs the gamut from fundamental studies on the breakdown mechanisms of protective coatings as temperatures increase, to the testing of commerically available coatings. Protective coatings are available which function properly under specific circumstances; however, to date, durable protective coatings for ultra-high temperatures are not commercially available. The great need for them has resulted in a large amount of research effort, but as yet this effort has produced no widely applicable solutions. (auth)

7517 (PWAC-499) REFRACTORY METAL PROTECTIVE COATINGS FOR LONG TERM APPLICATIONS. Friedrich, L. A.; Bornstein, N. S.; Hirakis, E. C. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Sept. 1965. Contract AT(30-1)-2789. 61p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A slurry applied coating was developed for the protection of refractory metal alloys in oxidizing, elevated temperature environments. The coating system, designated PWK-5, is based on a niobium silicide barrier layer interposed between the base metal and a refractory aluminide, tin-containing envelope. The methods used in the application of the coating are readily adaptable to large structural configurations. Mean lifetimes, derived from a statistical analysis of oxidation data for the PWK-5 coated Nb-1 Zr alloy composite exposed in 650 and 1100°C air, exceeded 6000 and 800 hrs, respectively. The reaction kinetics of the composite with air at temperatures from 538 to 1204°C conformed to a parabolic rate process. Evaluation of the factors affecting the behavior of the composite in 1093°C air indicated that the penetration of tin through the silicide barrier layer was the principal factor limiting coating lifetime. Thus, the analytical data confirmed the wearout mode of failure indicated by statistical analysis. Limited testing at 1427°C indicated that coatings designed with thicker silicide or alloyed silicide barrier layers may be capable of providing increased lifetimes. (auth)

7518 (PWAC-501) THE COMPATIBILITY OF STRUCTURAL AND TURBO-MACHINERY ALLOYS IN BOILING POTASSIUM. Blecherman, S. S.; Hodel, J. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Oct. 1965. Contract AT(30-1)-2789. 92p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The compatibility of candidate structural and turbomachinery alloys with boiling K was investigated with respect to the anticipated needs of advanced high temperature nuclear-Rankine space systems. The results of four natural circulation loop tests each operated for 3000 hrs at a nominal 1070°C boiling temperature are summarized. Nb-Zr-C alloy compositions and strength are essentially unaltered by exposure to a 1070°C boiling K environment. Nb-Zr alloys are capable of containing 1070°C boiling K without penetration attack or stress-induced corrosion. Potassium condensate apparently causes slight dissolution corrosion, but evaluation of the significance of the effect requires testing at realistic design conditions. Mo-TZM alloy appears to be compatible with wet K vapor at 1010°C, but a minor reduction in elevated temperature tensile strength was apparent. Compatibility between 650°C type 316 stainless steel and Nb-1 Zr alloy in K was considered adequate to warrant testing in a forced circulation loop. Properly designed vacuum chambers equipped with oil-diffusion pumps and liquid nitrogen baffles are capable of providing the high purity environments required for long duration tests of Nb and Ta alloys. (auth)

7519 (RCN-41) CALCULATION OF THE SAFE LIFE TIME EXPECTANCY OF ZIRCONIUM ALLOY CANNING IN THE FUEL ELEMENTS OF THE NERO REACTOR. van der Linde, A. (Reactor Centrum Nederland, Petten). July 1965. 40p. Dep. mn.

Based on the present day knowledge of the oxidation and hydridation behavior of Zirconium alloys under PWR conditions a calculation of the safe life time expectancy of Zirconium alloy canning in the fuel elements of the NERO reactor is presented. The decisive NERO conditions for life

time calculations are a heat flow of 100 w/cm^2 and a temperature of 345°C at the oxide-water surface. The calculations take account of the increase in oxidation rate under the influence of the heat flow and of the distribution of absorbed hydrogen in the canning wall in the radial direction. The maximum tolerable oxide or oxide + hydride layer thickness, on Zirconium alloy canning tubes, was fixed at 35 μ. The calculated data led to the conclusion that from the corrosion point of view the safe life time of Zirconium alloy canning tubes, having a wall thickness of 0.85 mm, operating under NERO conditions is 2.40 years for Zircaloy-2, 3.40 years for Zr-2.5% Nb and Zr-3% Nb-1% Sn, and 3.60 years for Zircaloy-4. (auth)

7520 BEHAVIOR OF FUEL ELEMENT CLADDING TUBES OF Zr ALLOYS IN HYDROGEN UPTAKE. Duerrschnabel, W. (NUKEM, Wolfgang, Ger.). Atomwirtschaft, 10: 560-2(Nov. 1965). (In German).

The possibility of decreasing hydrogen uptake by Zr alloys during reactor operation was investigated. The characteristics of the zirconium–hydrogen system are reported. The effect of hydrogen uptake on the corrosion of the alloys was studied. (J.S.R.)

7521 BEHAVIOR OF FUEL ELEMENT SHEETS OF ZIRCONIUM ALLOYS UNDER HYDROGEN UPTAKE. II. Duerrschnabel, W. Atomwirtschaft, 10: 682-5(Dec. 1965). (In German).

Modification of the mechanical properties of zirconium alloys and the damage resulting to fuel elements by hydride embrittlement are discussed. It was concluded that zirconium alloys, especially Zircaloy, are operationally safe under normal conditions in light water reactors. At temperatures of about 300°C a life span of 3 to 5 years was calculated. The alloys, however, under certain conditions are inclined to local and tense hydridation. (J.S.R.)

7522 RESEARCH ON CLADDINGS PROTECTING URANIUM AGAINST OXIDATION AT AVERAGE TEMPERATURES. Koch, P.; Dominget, R.; Baque, P.; Darras, R. Corros. Anti-Corros., 13: 249-69(Aug.-Sept. 1965).

The development of metallic claddings applicable to uranium in order to inhibit or limit the oxidation of U by carbon dioxide at high temperature was studied. The result was generally surface films based on intermetallic compounds or solid solutions with Al, Zr, Cu, Nb, Ni, or Cr. The conditions for the use of these claddings were optimized as a function of the protective effect observed in carbon dioxide at 450 or 500°C. Direct diffusion beginning with a film or a thin sheath, metallization under vacuum, or immersion in fused baths of suitable composition seemed particularly advantageous. Only the claddings with Al on Zr bases had clear advantages. They could reduce by a factor of 10 the oxidation rate of U under the conditions studied and could prevent to a large measure the formation of powdered oxide. The claddings developed assured, in general, a good protection for the U against atmospheric corrosion. (tr-auth)

7523 CORROSION OF TANTALUM AND TANTALUM–TUNGSTEN ALLOYS IN 20 PERCENT HYDROFLUORIC ACID. Eberts, R. E. (National Research Corp., Newton, Mass.). Corrosion, 21: 337-9(Oct. 1965).

Experimental data reported show that tantalum and tantalum–tungsten alloys containing less than 22 percent tungsten are more susceptible to attack by 20% hydrofluoric acid than was previously reported. (auth)

7524 CORROSION OF MAGNESIUM ALLOYS FOR NUCLEAR REACTORS IN CARBON DIOXIDE. Ito, Goro (National Res. Inst. Metals, Tokyo); Sawayanagi, Fumio. Keikinzoku, No. 72, 32-42(July 1965). (In Japanese).

The effects of temperature, pressure, and impurities present in carbon dioxide gas on the corrosion of magnesium alloys for gas-cooled reactors were studied. Test alloys were magnesium alloy with a small addition of aluminum and beryllium, i.e. so-called magnox AL-80 alloy. Tests were conducted in carbon dioxide gas at temperatures of 400–600°C, at pressures of 1–100 kg/cm^2, under stresses of 0–0.146 kg/mm^2, and at flow rates of 0–10^4 cc/min. The penetration rate of magnox alloy in static carbon dioxide gas was about $6-8 \times 10^{-4}$ mm/year and $1-4 \times 10^{-3}$ mm/year at temperatures of 400 and 500°C, respectively, and the rate increased with testing gas pressure from 1 kg/cm^2 to 50 kg/cm^2. The activation energy of the oxidation reaction of the alloy in carbon dioxide at a pressure of 50 kg/cm^2, calculated from an Arrhenius' plot of the experimental data, was 21,580 cal/mole. The presence of oxygen, water vapor up to 2%, and nitrogen up to 5% in carbon dioxide did not affect the corrosion behavior of the test specimen; however, the increase in corrosion rate and the occurrence of blister-type corrosion was noted when the amount of water vapor exceeded 5%. The formation of intergranular cavities or oxidation was not observed in magnox alloy heated in carbon dioxide gas to 500°C even under stress. The corrosion rate of the alloy in flowing carbon dioxide at flow rates of 100–500 cc/min was about 2 times faster than that in static gas. This effect cannot be solely attributed to the production of carbon monoxide during reaction, because the equilibrium constant for the reaction $Mg + CO_2 = MgO + CO$ at 400°C is about 5.46×10^{23} and hence the minimum percentage of CO_2 in a $CO + CO_2$ mixture necessary to oxidize magnesium is estimated as only 5.5×10^{-22}%. It is rather suspected that the vaporization of magnesium may play a role in the increase of metal loss of specimens at a high flow rate. (auth)

7525 STAINLESS-STEEL-CLAD FUEL ROD FAILURES. Duncan, R. N.; Arlt, W.H.; Williamson, H. E.; Baroch, C. J.; Hoffmann, J. P.; Pashos, T. J. (General Electric Co., San Jose, Calif.). Nucl. Appl., 1: 413-18 (Oct. 1965).

Experience with stainless-steel-clad fuel rods irradiated in the Vallecitos Boiling Water Reactor (VBWR) showed that type-304 stainless steel is susceptible to stress-assisted intergranular corrosion attack. Failure of over 40 fuel rods clad with this material occurred during irradiation of 950 fuel rods of several different types. The failures occurred at the peak surface heat flux region of the fuel rods and ranged from microscopic penetrations to multiple large cracks that were invariably intergranular. No precipitates could be observed in the austenitic grain boundaries of failed cladding samples using both optical and electron microscopy. Statistical analysis of the failure-rate data indicated that the failure rate for type-304 stainless-steel cladding, which was initially annealed, was not different from the failure rate for initially cold-worked cladding. The failure rate of collapsed cladding was significantly higher than for free-standing cladding. The operating stress level of the cladding appeared to be a major factor in susceptibility to failure. Evidence of localized plastic deformation of the cladding at UO_2 pellet interfaces was obtained and may contribute to the nucleation or propagation of the stress-assisted corrosion attack of the type-304 stainless-steel cladding. (auth)

7526 DEVELOPMENT OF TEST TO SIMULATE INTERGRANULAR CRACKING OF NONSENSITIZED STAINLESS STEEL IN WATER REACTOR ENVIRONMENTS. Pickett, A. E.; Pearl, W. L.; Rowland, M. C.; (General Electric Co., San Jose, Calif.). Nucl. Appl., 1: 453-61(Oct. 1965).

Nonsensitized type-304 stainless-steel fuel cladding cracked intergranularly when exposed to high-temperature, high-purity, water reactor environments. Similar failures were produced out of the reactor in stressed tubular-capsule specimens exposed to dilute solutions of iron chloride, copper chloride, sodium hydroxide, and chromic acid at 650°F (343°C). An iron chloride test was developed, which closely simulates the intergranular attack on stressed nonsensitized type-304 stainless-steel fuel cladding. Stressed, cold-worked, nonsensitized type-304 stainless-steel tubing cracked in less than 24 hr at 650°F when exposed to ferric-ferrous chloride solutions containing only 40 Cl parts/10^6 and 4 soluble-iron parts/10^6. Exposure at 650°F caused intergranular cracking only, while exposure at 550°F (288°C) caused mixed transgranular and intergranular cracking. The accelerated autoclave test can be used for screening of prospective cladding materials

and alloy modifications and developing a better understanding of the mechanism of attack. (auth)

7527 INVESTIGATION OF SCALE STABILITY OF ALLOYS OF ZIRCONIUM BORIDE WITH MOLYBDENUM DISILICIDE. Kuzenkova, M. A.; Kislyi, P. S. Porosh. Met., Akad. Nauk Ukr. SSR, No. 10, 75-9(Oct. 1965). (In Russian).

The process of oxidation of pure zirconium boride and systems of zirconium boride with molybdenum disilicide $(ZrB_{1.9})_{23}MoSi_{1.1}$ and $(ZrB_{1.7})_{13}MoSi_{1.2}$, obtained by sintering a mixture of zirconium boride with 5 and 10% molybdenum disilicide was studied. The rate of oxidation was determined by the change with time of the mass of the samples and the thickness of the oxide film. On the basis of the kinetic curves of oxidation and a microstructural analysis, a conclusion was drawn as to the nature of the formed films. Alloys of zirconium boride with molybdenum disilicide had a high scale stability up to 1550°C, because of the formation on the surface of a borosilicate oxide film. (auth)

7528 COATINGS ON REFRACTORY METALS. Leeds, D. H. (Aerospace Corp., El Segundo, Calif.). pp 197-217 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

The problems and potentials of oxidation-resistant ceramic coatings for refractory metals are discussed. The complexity of the oxidation and the oxidation mechanism as a function of time and temperature are considered. Fabrication methods for ceramic coatings and the resulting microstructure are described. Methods of testing and evaluating the coatings are reviewed. Optimum properties for ceramic coatings are listed. (9 references.) (F.J.H.)

7529 DEOXIDATION OF STEEL BY LANTHANUM, CERIUM, PRASEODYMIUM AND NEODYMIUM. Vishkarev, A. F.; Kryakovskii, Yu. V.; Yavoiskii, V. I. pp 204-8 of Vopr Teor i Prim Redkozem Met. Moscow, Nauka, 1964.

The deoxidizing capacity of La, Ce, Nd and Pr was studied. Thermodynamic calculations were carried out to determine the equilibrium constants of these elements when reacting with oxygen in molten Fe at steelmaking temperatures. Results of test heats effected under a steam–hydrogen mixture in crucibles made from various refractories (Al_2O_3, ZrO_2, MgO and BeO). Rare-earth metals have a considerable affinity for oxygen and therefore readily reduce oxides of the type Al_2O_3, ZrO_2 and BeO. The deoxidizing capacity of the rare-earth metals was therefore determined by an indirect method. The temperature relations K_{deox} were found. (Rev. Metal Lit.)

7530 STUDY OF THE OXIDATION KINETICS OF Mo–Al–Si ALLOYS. Parfenov, N. K.; Chuyan, A. M. pp 155-8 of Issled Stalei i Splavov. Moscow, Nauka, 1964. (In Russian).

Mo alloys containing 6.9% Al, 7.18% Si(I), and 27.63% Al 9.58% Si(II), were smelted in an arc furnace with a W electrode. The alloys were oxidized in a shaft-type furnace at 800–1200°C. The oxidation kinetics was studied by using the method of continuous weighing. The weight of I at all temperatures changes negatively because of the volatilization of MoO_3. Moreover, the loss in weight increases with the increase in temperature. The scale consists of $Al_2O_3 \cdot SiO_2$ (Mo, Al)$_2O_3$ and $3Al_2O_3 \cdot 2SiO_2$. The gain in weight of II in the process of oxidation did not exceed 1 mg/cm^2 in 5 hr. In 70 hr the oxidation rate at 1100°C was 0.008 mg/cm^2 × hr. A thin-scale layer was firmly bound to the metal. The x-ray investigation shows that at 1100°C the scale consists mainly of (Mo, Al)$_2O_3$ oxide which has a hexagonal lattice with a = 7.94 kX, c = 10.58 kX. (Rev. Metal Lit.)

Fabrication

Refer also to abstracts 8373, 8433, and 8466.

7531 (BNWL-150, pp 4.1-17) JOINT FUEL DEVELOPMENT PROGRAMS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Progress is reported in programs on irradiation testing of EBWR prototypic fuel rods, urania–plutonia fast fuel development, densification of sol-gel thoria, IPD PCTR Al–Pu alloy and thoria fuel rods, pneumatic-mechanical impaction of plutonia, ^{240}Pu and ^{241}Pu irradiation samples for Phillips Petroleum, Saxton fuel fabrication, and fabrication of Al–HfO_2 and Al–B rods. (W.L.G.)

7532 (BNWL-150, pp 5.1-33) DEVELOPMENT OF ADVANCED FUEL CONCEPTS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Work is in progress on postirradiation examination of high and low density stainless steel–20 vol. % PuO_2 cermets irradiated to 2.3% burnup of the Pu atoms. The feasibility of using a jet-grinder to produce high density, rounded particles from angular UO_2 (or PuO_2) particles was demonstrated. After only 30 min of grinding, the particles appear to be sufficiently round to provide the desired features expected of spherical particles when used in cermets. Three different spheroidizing techniques were used to prepare dense UO_2 spheroids. The three techniques are based on the following conditions, respectively. Tendency for UO_2 fines to agglomerate into small spheroids (maximum about 100 mesh) and to coat irregular, coarse particles in a snowballing effect during ball milling. Tendency for certain additives (e.g., CaO, TiO_2 powder and organic binders) to agglomerate micronized UO_2 into spheroids during ball milling with coarse UO_2 particles. Rounding of green pressed granules of UO_2. The final particle size and required density influence the choice of starting materials and spheroidizing process. Ceramic grade UO_2 plus binder were wet blended to produce spheres easily and quickly. Depending upon the sintering technique, densities range from 72 to 91% theoretical density. An experimental fuel assembly of cored UO_2 pellets enriched with Pu alloy wire helixes was fabricated for irradiation in the MTR. Magnetic force welding was shown to be applicable to the joining of thoria dispersed (TD) nickel. The strengths of magnetically forced welded TD nickel are comparable to any other joining process. A 3 ft long prototypic inverted cluster UO_2 fuel element was fabricated by vibrational compaction. (W.L.G.)

7533 (BNWL-SA-413) PREPARATION OF UO_2–PuO_2 SPHERES. Bardsley, R. E.; Lyon, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 15, 1965. Contract AT(45-1)-1830. 4p. (CONF-651119-2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Libby Cockcroft Information Exchange Meeting, Harwell, Eng.

A method is described for the preparation of dense spherical particles of sintered UO_2–PuO_2. Initial examination of the mixed oxide particles indicated a density greater than 90% TD. However, the process is not well suited for the production of particles with a size smaller than 100 mesh. (P.C.H.)

7534 (EURAEC-1208) METHODS FOR THE FABRICATION OF PRESSURE VESSELS. Quarterly Report No. 11, October 1–December 31, 1964. (Neratoom, N. V., The Hague (Netherlands)). Contract 069-61-12 RDN. 69p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

A description of the arc welding under a metal oxide powder cover of 200 mm thick 1.2 MD07 steel plates and the results of subsequent nondestructive and destructive testing of the welds is given. (W.L.G.)

7535 (IS-T-48) RESONANT FREQUENCY DETERMINATIONS APPLIED TO SINTERING PHENOMENA [Thesis]. Marlowe, Mickey Orville (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 112p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

A resonant frequency parameter computed from the flexural resonant frequencies of a prismatic bar before sintering and during the sintering process was derived. The parameter is related to the linear shrinkage of the bar by a simple multiplier. The multiplier typically takes on values >25 for unfired oxide samples. Because of the large mag-

nitude of the multiplier, the very early stages of sintering that are not readily studied by direct dilatometric techniques can be easily observed through changes in the resonant frequency parameter. This technique was applied to yttrium, erbium, dysprosium oxides, and Linde A aluminum oxide. Measurements were made at temperatures as low as 0.2 T_m (T_m = absolute melting temperature). The sintering data indicate a temperature dependent end point density. The relation $S = S_{MT} \sin \nu (\pi/2) (t - t_0/t_{MT} - t_0)$, where S is the linear shrinkage, t is the elapsed time, t_0 is the equivalent starting time if the sample were heated instantaneously to the test temperature, S_{MT} is the maximum shrinkage, t_{MT} is the characteristic time required to reach the end-point density, and ν is a temperature dependent constant, was found to accurately describe the sintering behavior of these materials. The maximum shrinkage at a given temperature was found to obey an Arrhenius type relationship for yttrium, erbium, and dysprosium oxides. Apparent activation energies for the sintering process over the temperature ranges studied for these materials are given. Adjunct to the major study the temperature dependence of the relative Young's modulus of elasticity of erbium oxide and dysprosium oxide were determined to approximately 1050°C. Least squares fit of the data for erbium and dysprosium oxides is discussed. (P.C.H.)

7536 (N65-25276) DEVELOPMENT OF LARGE SIZE FINISHED POROUS TUNGSTEN IONIZERS. Final Report. Graham, John W.; Malik, Raj K. (Astro Met Associates Inc., Cincinnati, Ohio). Mar. 18, 1965. Contract NAS-3-4115. 108p. (NASA-CR-54189; ASTRO MET-9-I-0032). CFSTI $4.00 cy, $0.75 mn.

Several large size porous tungsten emitter plates almost 4 square inches in area were prepared for NASA evaluation as a result of extensive powder metallurgy and chemical processes. The tungsten structural characteristics met, and in some cases exceeded, contract objectives. The structures exhibited mean pore diameters from 1.1 to 1.7 microns in discrete levels with very narrow desirable ranges, open pore volume between 19 and 24%, pore count between 0.9 to 4×10^7 pores/cm^2, and transmission coefficient between 11 and 22×10^{-5} plus thermal stability to at least 2750°F. The process consists of milling uniformly ultra fine tungsten, copper, and nickel powders, hydrostatically pressing, liquid phase sintering at 2150 to 2250°F for periods from 5 to 25 hours, hydrochloric and then nitric acid leaching to efficiently remove the copper and nickel phase, reducing in wet hydrogen at 1800°F, and vacuum bleaching at 2750°F. The process allows close control of grain size, pore diameter, and pore volume. In addition, it results in almost spherical tungsten grains and is believed to be easily reproducible. (auth)

7537 (NUMEC-3524-8) DEVELOPMENT AND TESTING OF UO_2-PuO_2 FAST REACTOR FUELS. Progress Report, July 1-September 30, 1965. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Nov. 22, 1965. Contract AT(30-1)-3524. 32p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Calculations of the film and capsule wall temperature drop for a fixed diameter of the fuel pins for the 4th and 5th rows in the EBR II Stagnant Sodium Capsule Test are given. Coprecipitated UO_2-15 wt. % PuO_2 fuel was found to have a better Pu and U homogeneity than mechanically mixed fuel. Extrusion tests of UO_2 with ethyl cellulose as the binder and perchlorethylene as the liquid failed to yield acceptable green and fired densities. The binder-liquid combination methyl cellulose-ammonium alginate-water yielded satisfactory green densities and low extrusion pressures after extended mixing. Results indicate that mixing is the most critical operation in the preparation cycle and that if inadequately or incorrectly performed, excessive extrusion pressures and low densities result. (W.L.G.)

7538 (ORINS-48) ELECTRODEPOSITION OF ACTINIDES AND LANTHANIDES. Kim, Stephen M.; Noakes, John E.; Akers, L. K.; Miller, W. W. (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). Dec. 15, 1965. Contract AT(40-1)-Gen-33. 20p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A systematic study of the quantitative electrodeposition of thorium, protactinium, and uranium was carried out for the preparation of thin film samples to be used in the field of nuclear spectral analysis. Under optimum conditions, yields of nearly 100% were realized with a reproducibility between samples of 2%. The electrodeposition method which was developed utilizes 95% ethanol as an electroplating solution with the electrodeposition being done on platinum metal. A study on some lanthanides was also carried out using the method. Qualitative predictions of optimum conditions of the electrodeposition of trace amounts of other elements were made utilizing similarities in the known properties of elements, such as the solubility products of their compounds and their reduction potential. (auth)

7539 ORDERED PACKED-BED FUEL ELEMENTS. Susskind, H.; Winsche, W. E.; Becker, W. (Brookhaven National Lab., Upton, N. Y.). Nucl. Appl., 1: 405-11(Oct. 1965). (BNL-8984).

The method described produces perfectly ordered packed beds of spheres that are dropped randomly into rigid rectangular columns. The method is applicable to loading fuel elements for many types of reactors. Experiments were conducted with 0.125-, 0.250-, and 0.500-in. (0.318-, 0.635-, and 1.270-cm)-dia stainless steel, bronze, and aluminum balls in 1.8- to 7.6-in. (4.5- to 19.3-cm)-wide square Lucite columns. Quantitatively reproducible ordered beds were obtained consistently. Irregular spheres as well as mixtures of two sizes of balls with diametral differences as great as 5% in 10 to 50% mixtures could be packed in an ordered fashion. The bed can be fluidized and subsequently resettled into an ordered array. These ordered beds were found to possess great structural flexibility because they move in spring-like fashion. This flexibility permits the fuel elements to compensate for thermal and hydraulic fluctuations and for radioinduced fuel swelling. (auth)

7540 MANUFACTURE OF PARTS FROM MOLYBDENUM BY THE METHOD OF PLASMIC POWDERING. Andreev, V. V.; Bobrov, G. V.; Polezhaev, M. A. Porosh. Met., Akad. Nauk Ukr. SSR, No. 10, 38-46(Oct. 1965). (In Russian).

The structure and physico-chemical properties of molybdenum obtained by plasmic powdering were studied. Ways were found for improving the structure and physico-chemical properties of powdered molybdenum by annealing the metal in a hydrogen medium under optimal conditions. Regularities were obtained in the behavior of powdered molybdenum at various annealing temperatures in a hydrogen medium, taking into account the change in the time of treatment. A technological process is proposed for manufacturing parts and units of molybdenum by plasmic powdering. (auth)

7541 FABRICATING REFRACTORY-METAL HONEYCOMB STRUCTURES. Schwartz, Mel M. Tool Mfg. Engr., 54: No. 4, 57-60(Apr. 1965).

The alloys D-36 (Nb-10Ti-5Zr) and Mo TZM (Mo-0.5Ti-0.07Zr) were used to make honeycombed-sandwich panels to be coated and used as heat shields. The panels consisted of a nonload carrying heat shield which requires enough high-temperature strength to transmit the load to the honeycomb core and the cooled inner plate. The cores were fabricated from corrugated strips which were built up and electron beam welded to form the honeycomb. Core sizing and shaping of D-36 with a band saw, belt sander and by step cutting with a disk cutter. To do the same with TZM the core had to be filled with sodium thiosulphate. Heat shield facings of 0.008 in. thickness were punch formed with the material placed between two-0.002 in. stainless steel sheets while held by rubber pads. These facings were manually trimmed and welded at 250°F to the honeycomb by electron-beam welding and relieved at 2200°F. The $\frac{5}{16}$ in. back plates were brazed in place to minimize thermal expansion and kept a flatness tolerance of ±0.0015 in. Brazing was done with Ti alloys in a cold wall vacuum furnace at 2150 ± 50°F. Exposed braze joints were sealed by electron beam welding to prevent interaction during oxide coating. Mechanical

testing of the panel showed desired results for D-36, but sealing and brittleness problems limited the use of TZM above 2400°F. (Rev. Metal Lit.)

7542 INFLUENCE OF ORIGIN OF UO_2 ON THE MICROSTRUCTURE OF SINTERED URANIA PELLETS. Moorthy, V. K. (Atomic Energy Establishment, Trombay, Bombay). Trans. Indian Inst. Metals, 18: 61-5(June 1965).

UO_2 powders were prepared by three methods: from ammonium diuranate prepared by precipitation with ammonium hydroxide, from ammonium diuranate prepared by precipitation with urea, and from uranyl tannate. The crystallite size, surface area, particle size, and density of these UO_2 powders were determined. Small pellets made from these powders were fired in hydrogen atmospheres to different temperatures between 1300 to 1650°C at different heating rates. The sintered densities, open and closed porosities, and the grain structure of the sintered UO_2 pellets were studied. It was found that the maximum densification occurred at an optimum firing temperature, specific for each of the powders. Grain development and growth was influenced by the size and distribution of the pores developed during sintering and thus indirectly by the origin of the powder. On sintering to 1650°C, the grains developed in UO_2 prepared from ammonium diuranate by ammonia precipitation were the largest, and those from the tannate the smallest; pellets of high density and desired microstructure can be obtained from different powders, by controlling the sintering conditions to suit the characteristics of the powder being used. (auth)

7543 INFLUENCE OF MINOR ADDITIONS ON THE SINTERING BEHAVIOUR OF URANIUM DIOXIDE. Moorthy, V. K.; Mishra, C. S. (Atomic Energy Establishment, Trombay, Bombay). Trans. Indian Inst. Metals, 18: 83-8(June 1965).

The influence of additions of titania (TiO_2) on the sinterability of uranium dioxide was studied. It was found that minor additions of titania (even 0.01%) to urania promote densification. Sintering could also be accomplished at temperatures lower than those required for sintering of pure urania. The densification and microstructure of two urania samples of different origins, with and without titania additions, were studied under different conditions of sintering. (auth)

7544 THE SINTERING KINETICS OF TUNGSTEN IN THE PRESENCE OF A LIQUID PHASE. Kothari, N. C.; Russell, B. Trans. Indian Inst. Metals, 17: 199-210(Dec. 1964).

The sintering of W–Ni–Cu alloys between 1200 and 1600°C and effects of compacting pressure, liquid phase composition, particle size and sintering temperature on the rate of sintering. Results interpreted in terms of a diffusion mechanism and the rate constant was found by measuring the change in volume as a function of sintering time. The most likely mechanism for material transport during liquid phase sintering is dissolution from the surfaces of small particles and subsequent precipitation on the larger tungsten particles via the liquid phase. Activation energies obtained were found to be independent of binder phase composition but increased from 69 to 80 Kcal/mole when the percentage of the binder phase was decreased from 11 to 7%. The values of activation energy measured for the process are consistent with a surface diffusion mechanism. (Rev. Metal Lit.)

7545 DIFFUSION WELDING OF TITANIUM, TUNGSTEN, AND MOLYBDENUM CARBIDES. Evtushenko, A. L. pp 140-6 of Issled Stalei i Splavov. Moscow, Nauka, 1964.

The vacuum diffusion welding of titanium, molybdenum and tungsten carbides to one another and to Mo and W was studied. It was proved to be possible to diffusion weld these metals at comparatively low temperatures and in a low vacuum (10^{-2}–10^{-3} mm. Hg). The welds were studied and the microhardness of the new phases formed as a result of the reaction diffusion was determined. Suggestions are made on the mechanism of the diffusion welding process and the nature of the resultant phases. (Rev. Metal Lit.)

7546 METHOD FOR FABRICATION OF ZIRCONIUM OR NIOBIUM BASE RODS. Takahashi, Shuichiro (to Mitsubishi Atomic Power Industries, Inc.). Japanese Patent 1964-16759. Aug. 14, 1964. Filed June 11, 1961.

An improved method is proposed for fabrication of zirconium- or niobium-base rods. These materials are widely used as reactor structural materials because of their small neutron absorption cross sections, high melting points, good mechanical properties, and high corrosion resistance at high temperature. Powder of niobium- or zirconium-base material is packed in a metal can to a high density. After sealing, the canned powder is swaged below 500 or 600°C for zirconium- or niobium-base material, respectively, in order to sinter the powder to a high density. The canning is then removed by lathing, melting, or dissolving in acid to obtain the metal rod. (NSA of Japan)

7547 METHOD OF PREVENTING CARBURIZATION OF FUEL ELEMENT CLADDING METALS BY URANIUM CARBIDE FUELS. Webb, B. A. (to U. S. Atomic Energy Commission). U. S. Patent 3,219,541. Nov. 23, 1965.

A uranium carbide fuel and its method of production are described. Prior to jacketing, the uranium carbide fuel element slug is heated in a vacuum at 1000°C until UC_2 is converted to U_2C_3. The resulting UC + U_2C_3 composition of the fuel slug will not carburize the stainless steel cladding. (AEC)

7548 CERAMIC-MATRIX-TYPE FUEL ELEMENT WITH GRAPHITE FABRIC AFFIXED TO EXTERIOR SURFACE. Turner, Richard F.; Winkler, E. O. (to U. S. Atomic Energy Commission). U. S. Patent 3,224,944. Dec. 21, 1965.

A fuel element was developed, which is comprised of discrete fuel particles dispersed within a graphite matrix. Each particle is coated to prevent diffusion of fission products so that the matrix may be directly exposed to the coolant stream. Woven graphite cloth is affixed to the surface of the matrix to increase heat transfer from the fuel element to the coolant stream. (AEC)

Properties and Structure

See also CHEMISTRY — Inorganic and Physical Chemistry
PHYSICS — Solid State Physics

Refer also to abstract 8447.

7549 (AAEC/E-138) SINTERABILITY STUDIES ON VARIOUS BeO POWDERS. A Second Report. Bannister, M. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). June 1965. 28p. Dep. mn.

Six sulphate-derived beryllium oxide powders were studied and a comparison made of their powder properties and sintering behavior. Powders containing segregated impurities showed irregular grain growth and those with strongly bonded aggregates showed internal cracking during sintering. All powders sintered less readily in hydrogen than in nitrogen. Semiempirical equations are presented relating sintering temperature and the grain size at any sintered density to the powder surface area and the green density of the pressed compact. (auth)

7550 (AECL-2275) PHASE EQUILIBRIA STUDIES ON THE ALUMINUM–PLUTONIUM SYSTEM. Runnalls, O. J. C. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov. 1965. 24p. (CONF-651102-12). Dep.; AECL $0.50.

From Royal Commonwealth Society, 3rd International Conference on Plutonium, London.

A summary is presented of the solid state transformations that were observed recently in the intermetallic phases $PuAl_4$ and $PuAl_3$. Both phases are believed to be plutonium-deficient with little or no deviation from fixed compositions. The crystal structures of the α and β forms of $PuAl_4$ appear identical except for the distribution of vacancies in each. After examining a single-phase sample by x-ray powder diffraction techniques, the parameters for the previously published structure of orthorhombic

$PuAl_4$ were modified somewhat. Electron probe and density measurements on three of the four polymorphs of $PuAl_2$ that were identified ($9H_\alpha$, $9H_\beta$, 6H, and 3H) indicate that their compositions are identical. For cubic $PuAl_2$ an observed variation in lattice parameter within the range $a = 7.833 \pm 0.005$ Å could not be linked to a composition change. The perovskite-type compound $PuAlO_3$ was prepared inadvertently while heating Al–Pu intermetallics and was examined by powder diffraction methods. As a consequence it is proposed that $PuAlO_3$ is not rhombohedral as reported earlier but is isostructural with orthorhombic $BaTiO_3$. (auth)

7551 (BDX-613-77) EVALUATION OF CARBONYL NICKEL. Kogan, R. G. (Bendix Corp., Kansas City, Mo.). Sept. 1965. Contract AT(29-1)-613. 32p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Four samples of nickel deposited by the carbonyl process were examined for hardness, strength, porosity, microstructure, and chemical composition. Results are compared with reported values for electrodeposited nickel. Four distinct types of microstructure exhibited by the four samples were examined and probable process variables were assigned as causes. (auth)

7552 (BNWL-SA-380) HIGH STRAIN RATE HIGH TEMPERATURE MECHANICAL TESTING OF PLUTONIUM. Gill, S. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 22, 1965. Contract AT(45-1)-1830. 13p. (CONF-651119-4). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Libby Cockcroft Information Exchange Meeting, Harwell, Eng.

The development and evaluation of the equipment needed for glove-boxed operation is described. Initial measurements on a delta-phase Pu–1 wt % Ga alloy are given. (W.L.G.)

7553 (BNWL-SA-382) EXPANSION PROPERTIES OF Pu-1 wt. percent Ga ALLOYS. Taylor, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 25, 1965. Contract AT(45-1)-1830. 7p. (CONF-651119-6). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Libby Cockcroft Information Exchange Meeting, Harwell, Eng.

Dilatometric expansion tests with a Pu–1 wt % Ga alloy were compared with expansion data obtained using x-ray diffraction. Differences were observed due to the deformation of the dilatometer specimens. When the Pu–1 wt % Ga alloy dilatometer specimen deformed sufficient to be supported by a holder, the expansion curves obtained by the two methods agreed very well. (auth)

7554 (BNWL-SA-385) PHYSICAL PROPERTIES OF SEVERAL PLUTONIUM BASE INTERMETALLIC COMPOUNDS. Taylor, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1, 1965. Contract AT(45-1)-1830. 13p. (CONF-651119-7). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Libby Cockcroft Information Exchange Meeting, Harwell, Eng.

Physical property data are reported for the following plutonium binary alloys: Pu–Ru, Pu–Os, Pu–Co, Pu–Rh, Pu–Ir, Pu–Pd, Pu–Pt, and Pu–Si. It was found that the intermetallics studied had melting points in excess of 1000°C except for the Pu_2Co compound. Expansion coefficients were generally low indicative of strong bonding forces. In most cases, the compounds would be expected to be very strong under compression. However, the compounds were very brittle and hard to handle. (P.C.H.)

7555 (CONF-650559-8) THERMODYNAMICS OF THE URANIUM–MAGNESIUM–CADMIUM SYSTEM. Brown, George Martin (Argonne National Lab., Ill. Northwestern Univ., Evanston, Ill.). Feb. 1965. Contract W-31-109-eng-38. 29p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From American Institute of Chemical Engineers, 56th National Meeting, San Francisco.

Equations for Gibbs free energy, enthalpy, entropy, and heat capacity are presented for liquid and solid U, Mg, and Cd and their mutual solutions. Excess functions and activity coefficients are given. Phase diagrams are calculated and compared with experimental measurements. Properties for the ternary system are calculated. (auth)

7556 (DRI-1092-219) DETERMINATION OF PHASE EQUILIBRIA IN THE SYSTEM BeO–ThO_2. Final Report. Otto, Henry E. (Denver Research Inst., Univ. of Denver, Colo.). Sept. 30, 1965. Contract AT(11-1)-1092. 18p. (DRI-2482). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A study of the BeO–ThO_2 system has shown that a eutectic occurs at 70 mole % BeO (18.1 wt %) and 2155°C ± 5°. The solid solubility of ThO_2 in BeO below the eutectic temperature is less than 0.016 mole % ThO_2 (0.16 wt %), and the solid solubility of BeO in ThO_2 is less than 0.1 mole % BeO (0.0095 wt %). Small amounts of ThO_2 have no effect on the β to α BeO phase inversion. (auth)

7557 (DRI-1092-220) PHASE EQUILIBRIA OF THE TANTALUM-RICH REGION OF THE TANTALUM–TUNGSTEN–HAFNIUM AND TANTALUM–TUNGSTEN–ZIRCONIUM SYSTEMS. Quarterly Progress Report No. 4. Klodt, Donald T.; Yamamoto, Albert S. (Denver Research Inst., Univ. of Denver, Colo.). Sept. 1965. Contract AT (11-1)-1092. 14p. (DRI-2274). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Solid-state phase equilibria at 1600°C and 1100°C were determined for the tantalum-rich regions of the Ta–W–Hf and Ta–W–Zr alloy systems. The alloys were prepared by arc melting charges consisting of a 60 Ta-40 wt.% W master alloy with appropriate additions of tantalum and hafnium or tantalum and zirconium. The as-cast alloys were homogenized by means of a high-temperature vacuum heat treatment prior to the vacuum annealing treatments at the two isothermal levels. Metallographic examination of the annealed structures and x-ray diffraction studies of the alloys were used to determine the phase equilibria. The extent of the single-phase terminal solid-solution region in each system was determined for the two isothermal levels and data are presented in the form of schematic diagrams of the observed microstructures. (auth)

7558 (DRI-1092-221) STUDIES OF THE EFFECT OF INTERSTITIAL ADDITION ON THE PHASE EQUILIBRIA OF THE NIOBIUM-RICH REGION OF THE NIOBIUM–TUNGSTEN–ZIRCONIUM ALLOY SYSTEMS. Quarterly Progress Report No. 4. Yamamoto, Albert S. (Denver Research Inst., Univ. of Denver, Colo.). Sept. 1965. Contract AT(11-1)-1092. 12p. (DRI-2276). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The effects of carbon and oxygen additions on phase relationships in the niobium-rich region of the niobium-tungsten-hafnium and niobium-tungsten-zirconium alloy systems were investigated. The niobium-rich solid solution phase boundaries for the niobium-rich region of the niobium-tungsten-hafnium and niobium-tungsten-zirconium systems with the addition of nominal 0.01 wt.% C were established metallographically at 1600° and 1300°C. Similar data for the two alloy systems without intentional carbon addition are quoted from the previous investigation for comparison. The pronounced effect of small carbon additions in reducing the solid solution phase field was evident in the two systems. A limited number of the niobium-tungsten-hafnium and niobium-tungsten-zirconium alloys containing small quantities of oxygen is available to date and a majority of these have been heat treated. (auth)

7559 (DRI-1092-225) STUDIES OF THE EFFECT OF INTERSTITIAL ADDITION ON THE PHASE EQUILIBRIA OF THE NIOBIUM-RICH REGION OF THE NIOBIUM–TUNGSTEN–HAFNIUM AND NIOBIUM–TUNGSTEN–ZIRCONIUM ALLOY SYSTEMS. Quarterly Progress Report No. 5. Yamamoto, Albert S. (Denver Research Inst., Univ. of Denver, Colo.). Dec. 1965. Contract AT(11-1)-1092. 8p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The effects of small carbon and oxygen additions on the phase relationships of the niobium-rich region of the niobium–tungsten–hafnium and niobium–tungsten–zirconium alloy systems were investigated. The powder X-ray data for a series of the carbon-bearing niobium–tung-

sten–zirconium alloys are reported in tabular form. Preliminary observations made both in the oxygen-bearing niobium–tungsten–hafnium and niobium–tungsten–zirconium alloys are reported briefly. (auth)

7560 (EURAEC–1461) A STUDY ON EMBRITTLEMENT BY PLASTIC FATIGUE IN REACTOR VESSEL STEELS. Special Report No. 3, December 15, 1963–December 31, 1964. Annual Report. (Centre National de Recherches Metallurgiques, Liege (Belgium)). Contract 005-63-12 TEEB. 88p. (EUR-2388). Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

A parabolic relation was found between the total deformation per cycle of alternate biaxial bending and the number of cycles to failure to 10^3 cycles for ASTM A302B, Ducol W30, and Soudotenax 56 steels. The fatigue life of the steels was shortened by a series of alternate trapezoidal stresses, the extent dependent upon the test temperature and the steel type. Fatigue cracks appeared in the middle of the samples at about 50% of the total life. The change in the transition temperature with amount of plastic fatigue followed a trend of reaching a maximum at 20% of the fatigue life and then decreasing. (W.L.G.)

7561 (EURAEC–1489) DIFFUSION OF RARE GASES IN SOLIDS. Quarterly Report No. 21, July–September 1965. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Oct. 1965. Contract 028-64-1 TEE (RD). 25p. (EUR-2656). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

A uniform activation energy was found between 850 and 1250°C for the simultaneous diffusion of Ar-37 and Xe-133 in CaF_2 single crystals doped with 1 mole % U: $D_{Ar} = 1.4 \cdot 10^{10} \exp - 97300/RT$ and $D_{Xe} = 7.1 \cdot 10^7 \exp - 97300/RT$. Results obtained for argon diffusion in KI single crystals after low-level neutron irradiation are: above 450°C $D = 3 \cdot 10^{-3} \exp - 6800/RT$ and below 450°C $D = 1 \cdot 10^{-2} \exp - 22400/RT$. All the activation energies measured hitherto for the diffusion of argon in K-halides are tabulated. An interstitial mechanism for the diffusion is suggested in the case of KF and the high-temperature values for KCl to KI. Several references are cited. (P.C.H.)

7562 (IS–1181) A MODEL POTENTIAL CALCULATION OF ELECTRONIC BAND STRUCTURE FOR CRYSTALS HAVING THE FLUORIDE STRUCTURE. Kilgore, Benjamin Franklin; Keller, Joseph M. (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 71p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A model pseudopotential calculation was made to study band structure in crystals having fluoride structure. In particular, the potential depends upon two spatial and two core parameters. Variation of these parameters makes possible an investigation of the restrictions imposed upon possible parameter sets by consideration of the valence band symmetries and energy gap a particular potential produces. The existence of an energy gap was found to be in most instances the stronger of the two criteria. (auth)

7563 (IS-T–55) SUSCEPTIBILITY OF DILUTE La–Gd ALLOYS [Thesis]. Panousis, Nicholas Theodore (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 53p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

Susceptibility measurements are presented on dilute La–Gd alloys in the temperature range of 1.8 to 20°K. The results show Curie-Weiss behavior with ferromagnetic coupling indicated by the generally positive values of the Curie temperatures. The shift in the number of effective Bohr magnetons was used as a probe to determine the existence and polarity of conduction electron polarization by the magnetic impurity ions. Positive polarization was indicated by the observed shift. (auth)

7564 (IS-T–56) WETTING CHARACTERISTICS OF LIQUID LEAD–BISMUTH EUTECTIC ON STAINLESS STEELS [Thesis]. Cleary, David John (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 68p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The wetting characteristics of the lead-bismuth eutectic on three high chromium stainless steels, types 310, 410, and 430, and an alloy steel, 4¾ chromium–½ molybdenum, were determined. The method involved photographing a drop of lead-bismuth resting on the steel and obtaining from the photograph various dimensions of the drop profile. These dimensions enabled determination of surface tension and contact angles. Values for the work of adhesion and the spreading coefficient were found from the surface tension and contact angle results. To prevent excessive oxidation of the Pb–Bi melt, the drop was formed and photographed in vacuo. Using the formation of a 90° contact angle as the criterion for wetting, type 310 was wet at 515°C, type 410 at 540°C, type 502 at 580°C, and type 430 at 640°C. Below 560°C type 502 steel exhibited the highest contact angles, indicating the least tendency to be wet by the liquid metal. At higher temperatures, 430 steel was the least wettable. The surface tension values ranged from 405 dynes/cm at 460°C to 365 dynes/cm at 572°C. Selecting the most favorable container material for the lead-bismuth eutectic was found to depend on the particular conditions and operation for which it would be used. (P.C.H.)

7565 (IS-T–59) THERMAL HYSTERESIS AND INITIAL SUSCEPTIBILITY INVESTIGATION OF MAGNETIC TRANSITIONS IN SEVERAL RARE EARTH METALS [Thesis]. Jelinek, Frank Joseph (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 48p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Of the six metals investigated only Gd and Sm did not exhibit a thermal hysteresis effect as studied by initial susceptibility techniques. The effect is present in the region of the ferromagnetic transition in Tb, Dy, Ho, and Tm. It is interesting to note that the metals that exhibit thermal hysteresis effects also exhibit various screw-type spin configurations between T_N and T_C. A correlation appears to exist between thermal hysteresis effects and crystallographic changes in these materials giving rise to first-order transitions in the region of the ferromagnetic ordering temperature. The broad maximum in the χ'_m versus T°K plot of Gd at 215°K was correlated with recent anisotropy measurements. When χ_m becomes very large compared to D (e.g. at the Curie point) then $\frac{1}{4}\pi D$ is the measured term. The temperature dependence of magnetization in samples with different D varied considerably and thus it is conceivable that the anomaly observed in the Gd stringers sample at 215°K could be a result of the significantly smaller D for this sample as opposed to the Gd filings. It is thus possible that the Gd stringers result is only fortuitously near the anisotropy anomaly. The results obtained with Tb metal agree best with the neutron diffraction investigation of Tb. Of particular interest is the minimum in the χ'_m versus T°K which occurs between T_N and T_C at 224°K. Dy metal has a 13° thermal hysteresis effect which was three to four times larger than the thermal hysteresis effect in any of the other metals exhibiting this property. Correlated with this result is the fact that a very large magnetostrictive effect was observed in Dy. The maximum near 30°K in the χ'_m versus T°K plot of Tm was intermediate between the 38°K transition to a ferrimagnetic state. The large entropy change associated with the 105°K maximum in the heat capacity of Sm metal corresponded to a very small change in the magnetic moment of Sm metal at 105°K. (P.C.H.)

7566 (KR–99) HIGH TEMPERATURE LOW CYCLE FATIGUE OF AN EXTRUDED ALUMINUM–SILICON–MAGNESIUM–NICKEL ALLOY. Davies, V. de L.; Bakken, K. (Institutt for Atomenergi, Kjeller (Norway)). Oct. 1965. 16p. Dep. mn.

The strain fatigue properties of the LFA-3 aluminum alloy Al–12 Si–1 Ni–0.8 Mg (wt %) were investigated at 250, 300, and 350°C. The results, when plotted as log plastic strain range versus log number of cycles to failure, show good agreement with the general results reported

in the literature. From the present data it may also be concluded that, in the frequency and temperature range investigated, there is no correlation between frequency and number of cycles to failure for this particular aluminum alloy. This means that for a given plastic strain amplitude (or range) there is a definite number of cycles to failure which, within scatter, is independent of frequency and temperature. The stress, however, is both frequency and temperature dependent. (auth)

7567 (LA-DC-7278(Suppl.)) STUDIES ON THE EQUILIBRIUM TEMPERATURE FOR THE PLUTONIUM ALPHA-BETA TRANSFORMATION. Anderson, J. W. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [nd]. Contract W-7405-eng-36. 14p. (CONF-651102-13). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Royal Commonwealth Society, 3rd International Conference on Plutonium, London.

The effects of purity, thermal history and specimen shape on the equilibrium temperature for the alpha-beta transformation of Pu are discussed. (W.L.G.)

7568 (LA-DC-7545) SLIP IN ALPHA PLUTONIUM. Bronisz, S. E.; Tate, R. E. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 10p. (CONF-651102-14). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Royal Commonwealth Society, 3rd International Conference on Plutonium, London.

Initial results indicate that slip planes near $(11\bar{4})$, (213), and (323) are operative at room temperature. Slip in other planes was not ruled out, but the (020) plane did not appear important. (W.L.G.)

7569 (MLM-1283) REACTOR FUELS AND MATERIALS DEVELOPMENT–PLUTONIUM RESEARCH: APRIL–JUNE 1965. Wittenberg, L. J.; Grove, G. R. (Mound Lab., Miamisburg, Ohio). Dec. 10, 1965. Contract AT-33-1-GEN-53. 23p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The phase equilibria in the Pu–Ce–Fe system was studied. A eutectic valley extends across the diagram at approximately 13 at.% Fe with temperatures in the valley ranging from 411 to 660°C. All of the compounds of the three limiting binary systems display primary phase fields in the ternary system. No ternary compounds exist. As a result of extensive solid solubility, no ternary eutectics occur in the system. The Pu–U system was investigated by differential thermal analysis. The results were essentially in agreement with the literature diagram. The addition of Zr to Pu–U alloys of high U concentration lowers the decomposition temperature of the high temperature, BCC, solid solution phase. Studies of differential thermal analysis thermograms of Pu show that the peaks associated with the $\beta \rightarrow \gamma$, $\gamma \rightarrow \delta$, $\delta \rightarrow \gamma$, and $\gamma \rightarrow \beta$ phase transformations in high purity Pu appear more distinctly when the sample is properly annealed. The applicability of a thermal diffusivity measurement technique for measurements of ceramic materials was determined when the thermal diffusivity of a Pyroceram specimen was measured from 200 to 1000°C and compared with previously published values. The density of liquid Pu–22 at.% Ce alloy was measured from 662 to 824°C. The alloy expanded as it transformed from the liquid to the solid state. The viscosity-composition relationship was determined for eleven alloys that spanned the Pu–Ce phase diagram. A viscosity maximum was noted at 5 at.% Ce and a minimum at 14 at.% Ce. In addition, the liquidus temperature of each alloy was measured precisely. A study was made of the influence of various feed materials on the density of PuO_2 microspheres produced in the induction-coupled plasma torch. The amount and type of porosity in the feed material greatly influenced the quality of the microspheres produced. (W.L.G.)

7570 (NAA-SR-9643) SNAP REACTOR MATERIALS DEVELOPMENT, SELF-WELD STUDIES. Kellogg, L. G. (Atomics International, Canoga Park, Calif.). June 1, 1964. Contract AT(11-1)-Gen-8. 57p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A test program has been conducted to determine what material combinations have the least adhesion or are least likely to self-weld when they are in contact under load for long periods of time at high temperature and ultrahigh vacuum. Screening tests were conducted on one hundred and ten combinations while in the high-temperature, ultra-high-vacuum environment. The tests cover the temperature range of 700 to 1300°F, with test periods up to 3400 hours in vacuums below 10^{-7} Torr. The screening tests are classified into five basic groups: metal vs metal, metal vs ceramic, metal vs graphite, ceramic vs ceramic, and ceramic vs graphite. A sixth group was added to include the use of contaminant films with the other groups. Adhesion was noted for some combination in all groups tested. The combinations, in which the adhesion force was immeasurable, were assigned an adhesion force equal to the accuracy of measurement (0.1 lb). The data indicate that, in order to minimize adhesion, some contaminant film must be placed between the two surfaces. To simulate the required environmental conditions of the SNAP reactors, it was necessary to design and fabricate a new test facility. The equipment and procedures used are discussed to provide insight into evaluation of the data. (auth)

7571 (NAA-SR-9644) SNAP REACTOR MATERIALS DEVELOPMENT, ULTRAHIGH-VACUUM FRICTION STUDIES. Kellogg, L. G. (Atomics International, Canoga Park, Calif.). June 8, 1964. Contract AT-11-1-GEN-8. 62p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Experimental studies were conducted to determine what materials can be used in SNAP design to provide bearing compatibility. Screening tests were conducted on sixty-seven material pairs in sliding couple at ultrahigh vacuum. The friction couples are categorized into seven groups: metal vs metal, metal vs metal with dry lubricants, metal vs carbon, ceramic vs ceramic, ceramic vs ceramic with dry lubricants, metal vs ceramic, and ceramic vs carbon. Special tests were conducted using contaminant films with all groups. The theory is discussed together with practical applications. Data are presented to illustrate the effects of vacuum on sliding friction and the effects of vacuum on surface film formation. Results indicate that carbon-graphites and sodium-silicate bonded dry-film lubricants provide relatively low friction in vacua at 1000°F when coupled with Al_2O_3 (flame sprayed) surfaces. Data are presented to show how both the carbon-graphites and dry films may be used together to provide a low friction couple through the temperature range of 70 to 800°F while operating in high vacuum. Results also indicate that sintered carbon materials provide relatively high friction in vacua at 1000°F when coupled with metallic surfaces. Several possible brake materials are discussed. Data of friction coefficient vs temperature and friction coefficient vs 1000-in. travel are presented for possible brake material couples. The test facility and the test method by which these studies were conducted is also included to provide insight into the technique employed and the results of the data. (auth)

7572 (NASA-CR-54775) DETERMINATION OF ELEVATED-TEMPERATURE FATIGUE DATA ON REFRACTORY ALLOYS IN ULTRA-HIGH VACUUM. Quarterly Report No. 5, July 1–October 1, 1965. Honeycutt, C. R.; Sawyer, J. C. (TRW Equipment Labs., Thompson Ramo Wooldridge Inc., Cleveland, Ohio). Oct. 15, 1965. Contract NAS-3-6010. 25p. CFSTI $1.00 cy, $0.50 mn.

Notched fatigue tests were conducted on TZM alloy in the stress-relieved condition at an ambient temperature of 982°C and on TZC alloy after annealing at 1700°C at an ambient temperature of 1093°C. No well-defined endurance limit was observed in either alloy and fracture occurred in TZC at peak stresses as low as 9030 psi in 143 hrs (9.75×10^9 cycles). (auth)

7573 (ORNL-TM-1330) PARAMETERS OF ISOTHERMAL FISSION-PRODUCT DEPOSITION [Thesis]. Kress, Tommy Sylvester (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 97p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Experimental and theoretical studies on isothermal

fission product deposition are discussed. The wall interaction is defined. A specific objective was to provide a method for coupling standard gradient transport equations with a logical form for the surface interaction. An analytical model was developed and given experimental verification using stable iodine tagged with ^{131}I dissociated from a PdI_2 source. The deposition surfaces were stainless steel and mild steel held essentially at 500°F in a turbulently flowing helium stream. The distribution of the deposited iodine was determined by counting the surface activity with a NaI crystal connected to a single channel scintillation counter. The results indicated that fission-product deposition involves the same problems inherent in the many physical adsorption systems and chemisorption surface reactions of stable species. The conclusion most emphasized is that the transport behavior is important only for short-lived isotopes and nonequilibrium levels of deposition. (P.C.H.)

7574 (PWAC–479) THERMODYNAMIC PROPERTIES OF URANIUM MONONITRIDE. Vozzella, P. A.; DeCrescente, M. A. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Oct. 1965. Contract AT(30-1)-2789. 18p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The partial pressure of nitrogen over uranium mononitride was measured by Knudsen effusion experiments over the temperature interval 1910 to 2265°K. A linear least squares fit of these data is given by: $\log_{10}P_{N_2}$ (atm) = $8.279 - 2.874 \times 10^4\ T^{-1}$ where T is in °K. Based on the decomposition mechanism $UN_{(s)} \rightarrow U_{(l)} + \frac{1}{2}\ N_2$ (g) the second-law enthalpy and entropy changes are given by ΔH_{2100} = 65.9 kcal/mole and ΔS_{2100} = 19.0 eu. A third-law analysis results in a standard heat of formation at 298°K of $\Delta H^{\circ}_{298} = -74.4 \pm 2.0$ kcal/mole. (auth)

7575 (PWAC–481) THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF URANIUM MONONITRIDE. Hayes, B. A.; DeCrescente, M. A. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Oct. 1965. Contract AT(30-1)-2789. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The thermal conductivity of uranium mononitride, measured in the temperature range 900 to 1650°C, was quite temperature dependent below 1200°C. However, it was relatively temperature independent above 1200°C. At 1650°C the thermal conductivity was 0.26 watts/cm-C. The electronic heat conduction was estimated from electrical resistivity measurements and the Weidemann-Franz relationship. Thermal and electrical properties of UN were compared with those of UC. (auth)

7576 (RFP–548) A METALLOGRAPHIC HOT-STAGE FOR PLUTONIUM. Greeson, R. L.; Johns, W. L.; Jackson, R. J. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Oct. 22, 1965. Contract AT(29-1)-1106. 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A high-vacuum, hot-stage microscope suitable for use with plutonium is described. Excerpts from movie films of the alpha-to-beta and beta-to-alpha tranformation on high purity plutonium are also presented and discussed. (auth)

7577 (RPI–3176-1) PRECIPITATION PHENOMENA IN CERAMICS: THE SYSTEM $BaTiO_3$–$CaTiO_3$. Final Report. DeVries, Robert C.; Ansell, George S.; Cooke, Francis W.; Bradt, Richard C. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nov. 30, 1965. Contract AT(30-1)-3176. 27p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The effect of a dispersed second phase on the ferroelectric domain structure of $BaTiO_3$ was investigated and these effects correlated with changes in dielectric aging behavior. The dispersion was achieved by precipitating a $CaTiO_3$-rich solid solution from an initially homogeneous polycrystalline $BaTiO_3$–20 wt % $CaTiO_3$ solid solution. It was observed that the 90° domains became quite irregular in shape and decreased in thickness by an order of magnitude, from 0.2 to 0.03 μ when 20 wt % $CaTiO_3$ was added in solid solution to the $BaTiO_3$. The domain structure was only slightly coarser and more regular in solid solution single crystals, but the 90° domains become organized into bands similar to those observed in pure $BaTiO_3$ single crystals. Thus the thickness and regularity of the 90° domains is dependent on alloy content as well as on the strains inherent in polycrystalline $BaTiO_3$, while the banding behavior seems sensitive mainly to the strains. The precipitation heat treatments produced up to 7 vol % second phase at 1200°C with particle sizes up to 40 μ. Below 1000°C only a fraction of a percent of second phase was produced in the form of spherical particles with sizes down to less than 0.05 μ and a mean free path between particles of about 0.5 μ. The most unusual and significant result of this microstructure study was that no morphologically related precipitate could be produced by any heat treatment, despite the structural similarity of the phases involved. The temperature dependence of the aging rate for $BaTiO_3$–$CaTiO_3$ alloys is just the reverse of that for unalloyed $BaTiO_3$, indicating that aging is not simply a thermally activated process. The presence of second phase particles with a dispersion comparable to the size of the 90° domains has no observable effect on aging behavior, but as the composition of the alpha phase approaches that of pure $BaTiO_3$, the aging behavior also becomes more like that of pure $BaTiO_3$. (auth)

7578 (SGAE–M–3/1965) BESCHICHTUNG VON KERNBRENNSTOFFPARTIKELN MIT PYROLYTISCHEM KOHLENSTOFF. (Coating of Nuclear Fuel Particles with Pyrolytic Carbon). Koss, P.; Kofler, O.; Maerkl, H.; Wallisch, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). [1965]. 27p. Dep. mn.

The preparation of pyrolytic carbon coatings in fluidized beds and in fluidized beds with a central nozzle is described. The efficiency of a fluidized bed with porous plates was investigated. A production installation for the preparation of pyrolytic carbon coatings on nuclear fuel particles is described. The coated fuel particles were tested with respect to surface impurities, fission product permeability, and behavior in action zone. (J.S.R.)

7579 (TIM–850) SOLUBILITY OF REFRACTORY METALS IN LITHIUM AND POTASSIUM. Cleary, R. E.; Blecherman, S. S.; Corliss, J. E. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Nov. 1965. Contract AT(30-1)-2789. 61p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The solubilities of molybdenum and niobium were determined in lithium to 1320°C and in potassium to 1205°C. The effects of oxygen, nitrogen, and carbon added to the solvent were investigated. The solubility results were correlated with engineering loop results indicating that niobium and molybdenum base alloys should be acceptable for application in high temperature, high purity, liquid metal systems. (auth)

7580 (TIM–945) MODIFIED TIN–ALUMINUM SLURRY COATINGS FOR MULTI-THOUSAND HOUR APPLICATIONS. Friedrich, L. A.; Hirakis, E. C.; Bornstein, N. S. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Oct. 1965. Contract AT(30-1)-2789. 41p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Two slurry applied coating compositions, designated PWK-1 and PWK-35, were developed for the protection of refractory metals. Chromium and titanium additions to the basic tin-aluminum coating composition improved protection in air above 650°C. Mean lifetimes, derived from a statistical analysis of oxidation data for the PWK-35 coated Nb-1 Zr alloy and four Nb–Ti alloys, approximated 10,000 hours in 650°C air and ranged from 1500 hours for coated Nb-1 Zr alloys to 3500 hours for the coated Nb–Ti alloys in 871°C air. Procedures for applying the coating to engineering structures were developed. Encouraging results were obtained in tests to evaluate protection in impure helium environments for periods to 5000 hours at temperatures to 1093°C. (auth)

7581 (UCRL–14489) SOME OBSERVATIONS ON THE COMPRESSIVE CREEP BEHAVIOR OF A DELTA

STABILIZED PLUTONIUM-1 w/o GALLIUM ALLOY. Robbins, Jack L.; Wheeler, Alan D. (Lawrence Radiation Lab., Univ. of California, Livermore). Oct. 8, 1965. Contract W-7405-eng-48. 26p. (CONF-651102-11). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Royal Commonwealth Society, 3rd International Conference on Plutonium, London.

The compressive creep characteristics of a plutonium-1 wt % gallium alloy were evaluated at a constant stress of 2000 psi over the temperature range 234 to 387°C. In all cases the true strain versus time curves manifested a predominantly tertiary type of behavior. This accelerating creep rate was not caused by internal cavity formation; rather, it was related to partial recrystallization and possibly an enhancement in the recovery processes. The apparent activation energy for creep was determined to be 33.7 ± 2.5 kcal/mole independent of strain between values of 0 and 0.15. (auth)

7582 (UCRL-16271) IDENTIFICATION OF PRISMATIC DISLOCATION DEFECTS BY ELECTRON MICROSCOPY. Thomas, G.; Bell, W. L. (Lawrence Radiation Lab., Univ. of California, Berkeley). Aug. 1965. Contract W-7405-eng-48. 67p. (CONF-650956-1). Dep. mn; CFSTI $3.00 cy, $0.75 mn.

From Conference on Lattice Defects, Honolulu, Hawaii.

Two techniques, viz. diffraction and strain contrast, for identifying large and small prismatic dislocation defects by transmission electron microscopy are described. Large defects can be analyzed by inspection. If the defect is a pure edge loop, the dislocation has uniform contrast and, if faulted, characteristic fringe contrast is observed. If loops are not pure edge, a double-arc dislocation image occurs containing a line of weak contrast that is always normal to the (projected) Burgers vector. Examples for fcc and bcc crystals are given. If the defect is large enough, the plane containing the dislocation loop can be identified. A method involving simple tilting experiments away from the s = 0 condition in dark field is described that enables the sense of the defect to be determined (i.e., vacancy or interstitial). For defects too small to be adequately resolved by diffraction contrast, dark-field strain-contrast imaging must be used. It is shown how various kinds of possible defects can be distinguished, and the conditions required to produce and identify strain-contrast images are described. (auth)

7583 (UCRL-16326) DECOMPOSITION REACTIONS IN GOLD-PLATINUM ALLOYS AND THEIR EFFECTS ON STRENGTH AND FRACTURE CHARACTERISTICS. Parker, E. R.; Carpenter, R. W.; Zackay, V. F. (Lawrence Radiation Lab., Univ. of California, Berkeley). Oct. 1965. Contract W-7405-eng-48. 32p. (CONF-650949-1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From International Conference on Fracture, Sendai, Japan.

The effects of spinodal decomposition on the mechanical behavior of alloys was investigated with special reference to gold-platinum alloys. The cause of brittleness and the hardening process were also studied. It was found that the mechanical properties of alloys in which there is a miscibility gap in the alloys system can become very brittle when quenched from the solid solution range, even though the solid solution phases themselves, if tested independently, would be relatively weak but ductile. A grain boundary precipitate of a weak but ductile material was the cause of the brittleness. In analysis of the rapid strain hardening phenomenon, it was concluded that the passage of dislocations in a lattice in which there was a variation in lattice parameter ranging from a maximum to a minimum in a relatively short distance would cause very rapid strain hardening to occur. (P.C.H.)

7584 (UCRL-16363) THE STRENGTH AND TOUGHNESS OF DYNAMICALLY STRAIN AGED ALLOY STEELS. Zackay, V. F.; Gerberich, W. W.; Busch, R.; Parker, E. R. (Lawrence Radiation Lab., Univ. of California, Berkeley). Oct. 1965. Contract W-7405-eng-48. 40p. (CONF-650949-2). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From International Conference on Fracture, Sendai, Japan.

The response of alloy steels to dynamic strain aging in both quenched and tempered and ausformed conditions were investigated. Strength, ductility, and toughness were measured as a function of straining and tempering temperatures. Structural observations were made on the strained and unstrained steels. By appropriate choice of strain and tempering temperatures, the strength of quenched and tempered steels was increased by about 40,000 psi, i.e., to the base strength of the ausform steels. The strength of the ausform steels was increased by about the same amount, suggesting that the strengthening effects are additive. In the ausform steels, yield strengths of 270,000 psi were achieved by dynamic strain aging with a reliability ratio (K_c/σ_{ys}) of one. Since the slope of K_c/σ_{ys} vs. σ_{ys} is small, it is suggested that this process may be used to attain yield strengths of 300,000 psi with exceptional toughness. (auth)

7585 (ANL-Trans-251) MAGNETIC INVESTIGATIONS ON MIXED CRYSTALS OF Pd WITH TRANSITION ELEMENTS. Gerstenberg, D. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Ann. Phys. (7)2: 236-62(1958). 30p. Dep. mn; JCL $2.60 fs, $1.10 mf.

Susceptibility measurements on mixed crystals of Pd with the transition elements Ti, V, Cr, Mn, Fe, Co, Ni, Zr, Nb, Mo, Ta, W, and Re where the 3d-, 4d-, and 5d-shells are built up were carried out in the temperature range between 90 and 1100°K. The results were interpreted on the basis of equations derived by Pauli and Stoner for the spin paramagnetism from the electron theory of metals. (auth)

7586 THE STRUCTURES OF YNi_3, YCo_3, $ThFe_3$ AND $GdFe_3$. Smith, J. F.; Hansen, D. A. (Iowa State Univ., Ames). Acta Crystallogr., 19: 1019-24(Dec. 10, 1965). (IS-1129).

The crystal structures of YNi_3, YCo_3, $ThFe_3$, and $GdFe_3$ were found to be isostructural with $PuNi_3$ in space group $R\bar{3}m$. The determinations for the first three of these phases were based on single-crystal data while the determination of the $GdFe_3$ structure was based on previously published intensity data taken from a polycrystalline specimen. There is evidence that these rhombohedral structures are susceptible to faulting with the stacking faults occurring normal to the c axis. Lattice parameters in the hexagonal representation were determined to be: $a_0 = 4.9779 \pm 0.0004$ and $c_0 = 24.449 \pm 0.003$ Å for YNi_3; $a_0 = 5.020 \pm 0.005$ and $c_0 = 24.40 \pm 0.03$ Å for YCo_3; and $a = 5.18 \pm 0.03$ and $c = 25.2 \pm 0.3$ Å for $ThFe_3$. (auth)

7587 A NEUTRON DIFFRACTION STUDY OF THE NOWOTNY PHASE $Mo_{\leq 5}Si_3C_{\leq 1}$. Parthe, Erwin (Univ. of Pennsylvania, Philadelphia); Jeitschko, Wolfgang; Sadagopan, Varadachari. Acta Crystallogr., 19: 1031-7(Dec. 10, 1965).

A neutron diffraction study of the Nowotny phase $Mo_{4.8}Si_3C_{0.6}$ combined with an x-ray diffraction analysis was used to determine the C atom positions and to refine the other structure parameters. The compound crystallizes in a hexagonal unit cell with $a = 7.286 \pm 0.001$ and $c = 5.046 \pm 0.002$ Å and in space group $P6_3/mcm(D^3_{6h})$ with six Mo atoms in position $6(g_I)$ with $x = 0.240$, only 3.6 Mo atoms in 4(d), six Si atoms in position $6(g_{II})$ with $x = 0.60$ and 1.2 C atoms in 2(b). The carbon atoms occupy the octahedral voids formed by the Mo atoms in position $6(g_I)$. It is shown that these carbon-centered transition metal octahedra are an important structural element not only of Nowotny phases but also of a whole group of complex transition metal carbides. From a knowledge of the tendency with which elements like to form T_6C octahedra, it is possible to predict the arrangement of the different atoms on the different structure sites of the complex ternary and quaternary carbides. (auth)

7588 THE FRICTION AND WEAR BEHAVIOR OF MOLYBDENUM-TUNGSTEN-CHROMIUM ALLOYS IN HIGH-TEMPERATURE SODIUM ENVIRONMENTS. Roberts, W. H. ASLE Trans., 8: No. 2, 109-22(Apr. 1965).

Friction and wear data, obtained with a crossed-cylinders apparatus, are presented for a selection of Mo–W–Cr alloys, over the temperature range 200 to 500°C for two sodium environments: the molten metal, containing approximately 5 ppm of oxygen impurity and pure argon containing sodium vapor at concentrations corresponding with the temperature equilibrium value. Some comparisons are made with results obtained in gaseous environments of pure argon, helium and carbon dioxide. An indication is given of the effect on friction and wear behavior of increasing the oxygen content in liquid sodium from about 5 to 80 ppm. It was concluded that chemisorbed double-oxide films, formed by reaction of the Mo, W and Cr constituents of the alloys with the sodium environment, play a significant role in providing boundary lubrication in high-temperature sodium. The effectiveness of the lubrication provided by such films is a function of the specific nature of the sodium environment (vapor or molten state), and temperature, as well as time at temperature. (Rev. Metal Lit.)

7589 THE ELECTRICAL CONDUCTIVITY OF ZIRCONIUM DIOXIDE FILMS AT INTERMEDIATE TEMPERATURES. Dawson, D. K.; Creamer, R. H. (Brunel Coll., London). Brit. J. Appl. Phys., 16, 1643-7(Nov. 1965).

The a-c electric conductivity of zirconia was measured as a function of temperature for various electrode materials. Reproducible results were obtained after the removal of surface conduction effects by heating specimens to a temperature of 180°C. An activation energy of 0.56 ev was found for the conduction process in the temperature range 250–300°C. Results obtained using an indium electrode may be interpreted in terms of an n-type electronic conduction process. The anomalous results obtained with a silver electrode are explained in terms of the diffusion of silver along grain boundaries. (auth)

7590 DILATOMETRIC AND MAGNETIC STUDIES OF PURE METALLIC SAMARIUM BETWEEN 77 AND 300°K. La Blanchetais, Charlotte Henry (CNRS, Bellevue, France). Compt. Rend., 261: 3423-6(Oct. 27, 1965). (In French).

The changes in length of a sample of metallic Sm as a function of temperature were measured, for increasing and decreasing temperature, between 77 and 300°K. Between 165 and 290°K, the variation is nearly linear; the corresponding coefficient of dilatation is 7.8×10^{-6}. Between 95 and 115°K, the variation shows an anomaly and slight hysteresis; the coefficient of dilatation is -8.4×10^{-6} for increasing temperature and -8.1×10^{-6} for decreasing temperature. Below these temperatures, the coefficient is practically zero. Measurements of the magnetic susceptibility χ between 77 and 300°K in a field of 6350 Oe were also carried out. The variation of the susceptibility with temperature is very weak; a very small break in the curve $\chi = f(T)$ is observed in the region of the dilatation anomaly. It is concluded that pure metallic Sm possesses frozen magnetic moments and that the Sm^{3+} ions in the metal behave very differently from those in Sm compounds. (M.J.T.)

7591 MONOGERMANIDES OF THE RARE-EARTH METALS AND THEIR CRYSTAL STRUCTURES. Gladyshevskii, E. I.; Ugrin, N. S. (Lvov State Univ.). Dopov. Akad. Nauk Ukr. RSR, No. 10, 1326-9(1965). (In Ukrainian).

X ray and microscopical methods were used to investigate the alloys R–Ge (R = La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu). The existence of the compounds LaGe, CeGe (type FeB) and PrGe, NdGe, SmGe, EuGe, GdGe, TbGe, HoGe (type CrB) was established. Lattice periods are given. (auth)

7592 MAGNETIC PROPERTIES OF IRON–NEODYMIUM ALLOYS. Chechernikov, V. I.; Speranskii, N. M.; Maslova, E. V.; Terekhova, V. F. (Moscow State Univ.). Fiz. Metal. Metalloved., 20: 299-301(Aug. 1965). (In Russian).

The magnetic properties of Fe–Nd alloys were studied throughout the whole concentration range at 300 to 1300°K. The alloys were prepared in purified He atmosphere in an arc furnace and were annealed in quartz tubes. Microstructural and x-ray diffraction analysis revealed the existence of 2 compounds, $Fe_{17}Nd_2$ and Fe_2Nd, formed by peritectic reactions at 1085 and 1050°C, respectively. The solubility of Nd in Fe at room temperature does not exceed 0.3 to 0.4 wt %; that of Fe in Nd, 0.1 wt %. Most of the alloys were found to contain 2 phases, consisting of a mechanical mixture of the solid solutions and the compounds. The magnetization isotherms determined at temperatures below 400°C indicated nearly complete saturation. The ratio of the specific magnetization at higher and at room temperatures σ_t/σ_o differed from the values found for d type metals. Alloys containing 10.52 to 85 at. % Nd exhibited below the Curie point of $\theta_f \cong 750$°C a range of minimum magnetization at about 350°C, followed by an increase and a return to 0 at $T = \theta_f$. The temperature dependence of the inverse magnetic susceptibility follows the Curie-Weiss law, except at high temperatures, where an $\alpha \rightarrow \gamma$ transformation takes place. The properties of the Fe atoms predominate the magnetic properties of the Fe-Nd alloys throughout the whole concentration range. (TTT)

7593 MAGNETIC PROPERTIES OF V–Ta ALLOYS. Chechernikov, V. I.; Nefedov, A. P.; Sokolovskaya, E. M. (Moscow State Univ.). Fiz. Metal. Metalloved., 20: 302-3 (Aug. 1965). (In Russian).

In alloys of weakly magnetic metals, the temperature derivatives of the magnetic susceptibility $d\chi/dT$, usually possess different signs. This problem was studied in V–Ta alloys, since for both metals $d\chi/dT < 0$ and the electronic heat capacity is high. The alloys were prepared by melting in an arc furnace in an Ar atmosphere, followed by annealing in He. Studies carried out by examination of the microstructure, determination of the specific conductivity, and x-ray diffraction revealed that the annealed alloys form a single-phase system. Alloys in the 9 to 59 at. % Ta range subjected to supplementary annealing for 1500 hours at 900°C possess two phases, except in the case of the composition with 34 at. % Ta, corresponding to the compound TaV_2 which forms a single phase; its tetragonal lattice has cell parameters of c = 5.041 Å, a = 6.702 Å, and Z = 4. The magnetic susceptibility was determined in the temperature range from 77 to 1100°K. It was found that the specific magnetic susceptibility χ of the homogenized alloys changes smoothly throughout the whole concentration range, decreasing from a maximum value for pure V with increasing Ta content. At 34 at. % Ta, a marked increase of the susceptibility was noted in alloys subjected to additional annealing. The temperature dependence of $1/\chi$ was found to be linear throughout the whole temperature range studied. The slope of the curves pointed to a localization of d electrons. The $1/\chi$ value of the 34% alloy was practically temperature-independent. The TaV_2 compound is assumed to form a σ phase. (TTT)

7594 MAGNETIC PROPERTIES OF Eu_3O_4. Samokhvalov, A. A.; Bamburov, V. G.; Volkenshtein, N. V.; Zotov, T. D.; Ivakin, A. A.; Morozov, Yu. N.; Simonova, M. I. (Inst. of Physics of Metals, Academy of Sciences, USSR). Fiz. Metal. Metalloved., 20: 308-9(Aug. 1965). (In Russian).

The temperature dependence of the magnetization of Eu_3O_4 was measured at various field intensities at temperatures ranging from 1.65°K up. An applied external field of 19,300 Oe was sufficient to reach magnetic saturation. By extrapolating to $H = \infty$ the family of curves of $\sigma(H,T)$ obtained, the magnetic saturation value of the material was found to be $\sigma_s = 89.4$ gauss cm^3/g, while its Curie point was 7.8°K. In view of its relatively large moment of magnetization and low Curie point, the oxide is well suited for studying the spin-wave theory which predicts a linear correlation between the magnetic saturation and T^2; such a correlation was verified for the temperature range from 1.65 to 4.6°K. (TTT)

7595 TEMPERATURE DEPENDENCE OF MAGNETIC SATURATION IN A FERROMAGNETIC OXIDE EuO. Samokhvalov, A. A.; Bamburov, V. G.; Volkenshtein, N. V.; Zotov, T. D.; Ivakin, A. A.; Morozov, Yu. N.; Simonova,

M. I. (Inst. of Physics of Metals, Academy of Sciences, USSR). Fiz. Metal. Metalloved., 20: 309-10(Aug. 1965). (In Russian).

It was attempted to confirm the $\sigma = \sigma_0(1 - CT^{3/2})$ relation of the magnetic saturation of the ferromagnetic oxide EuO, derived from the spin–wave theory by Bloch, for spontaneous magnetization $\sigma(T)$ at a magnetic field of H = 0. The oxide is well suited for such a study because it has a high magnetic moment, $4\pi M = 24{,}100$ gauss, a low Curie point, $T_C = 74°K$, and a simple, NaCl-type structure. The measurements were carried at temperature from 1.7°K at an external field of 19,300 Oe. The results indicated that the linear relation between the magnetic saturation and $T^{3/2}$ is satisfied for the relatively broad temperature range from 1.6 to 43°K (0.6 T_C). (TTT)

7596 ELASTIC CONSTANTS OF Nb BY RESONANCE AT SONIC FREQUENCIES. Wasilewski, R. J. (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). J. Phys. Chem. Solids, 26: 1643-7(Nov. 1965).

Elastic compliances of single-crystal, high-purity, and commercial niobium were determined by the sonic frequency resonance method at 25°C. The conditions under which vibration mode mixing can be avoided are discussed, and a technique to check its absence is described. Unexpectedly low damping levels were observed. It was concluded that the precision of this method is comparable to that of the very-high-frequency methods more commonly used. (auth)

7597 STABILITY AND SUPERCONDUCTING TRANSITION TEMPERATURE OF THE A15-TYPE PHASE IN THE Mo–Pt SYSTEM: $Mo_3(Mo_{0.4}Pt_{0.6})$. Sadagopan, V.; Gatos, H. C.; Giessen, B. C. (Massachusetts Inst. of Tech., Cambridge). J. Phys. Chem. Solids, 26: 1687(Nov. 1965).

The composition limits, the temperature range of stability, and the superconducting transition temperature of the A15 phase in the Mo–Pt alloy are reported. Three alloys of Mo with 16, 20, and 25 at. % Pt were prepared by inert-gas arc melting from high-purity elements. The lattice constant of $Mo_3(Mo_{0.4}Pt_{0.6})$ was found to be $a = 4.989 \pm 0.001$ Å, which compared with previous values. The A15 phase in the Mo-Pt alloy was expected to be superconducting on the basis of known transition temperatures (Tc) of the A15 phases as a function of the position of their constituent atoms in the periodic table. The transition temperature of the A15 phase, $Mo_3(Mo_{0.4}Pt_{0.6})$, was determined by employing inductance techniques. A sharp transition was observed at 8.8°K, which was lower than predicted. (F.J.H.)

7598 ON THE DETERMINATION OF THE SIZE OF IRRADIATED NUCLEAR FUEL PARTICLES. Winter, K.; Trommer, E. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 8: 563-8(Sept. 1965). (In German).

A sedimentation procedure is described for determination of the size distribution of a fuel slurry by using the self-irradiation of active nuclear fuel particles in radiometric measurements. Although developed for this special purpose, the method described is, in general, suitable for determining grain sizes of activated powders. (auth)

7599 INVESTIGATION OF THE MECHANICAL PROPERTIES OF ALLOYS IN THE Cb–W–Mo–Zr SYSTEM. Baykova, A. A.; Savitskii, E. M.; Zakharov, A. M. Metalloved, Term. Obrabotka Metal., No. 3, 8-16(1965). (In Russian).

The hardness, elongation and reduction in area from 1300 to 1500°C of Nb-base alloy with total additions of W, Mo and Zr not exceeding 30% were tested. The quarternary alloy was produced by powder metallurgy, arc melting and vacuum annealing. It was determined that the hardening effect is achieved by formation of Mo_2Zr and W_2Zr dispersion hardening phases (secondary phases) which produce a high density of distortions in the lattice of the Nb matrix. (Rev. Metal Lit.)

7600 A METHOD FOR MEASURING SMALL DIFFUSION COEFFICIENTS. Gainotti, A.; Zecchina, L. (Univ., Parma). Nuovo Cimento (10), 40B: 295-9(Nov. 11, 1965).

A method which is effective in measuring diffusion coefficients as small as 10^{-16} cm^2/sec is proposed and adopted in the case of the self-diffusion of gold in the temperature range between 350 and 460°C. The conditions under which the method can be used are discussed. (auth)

7601 CRACK PROPAGATION IN SINGLE CRYSTALS OF TUNGSTEN. Hull, D.; Beardmore, P.; Valintine, A. P. (Univ. of Liverpool, Eng.). Phil. Mag. (8), 12: 1021-41(Nov. 1965).

The effect of pre-existing micro-cracks on the fracture of [010] tungsten single crystals was investigated. Cleavage cracks on (010) planes were introduced into the edge of the specimens by a spark-machining technique. Tensile tests at 77°K showed that the fracture stress was dependent on the crack length according to the Griffith criterion. At this temperature the specimens failed in a completely brittle manner. A surface energy of 6300 ergs cm^{-2} was obtained in close agreement with the theoretical value for the true surface energy. Metallographic examination of the fracture surfaces showed that the markings on the surface depended on the stress level at fracture. One test was carried out to determine the effect of prestraining at 295°K on the subsequent fracture behavior at 77°K. The effect of temperature on the fracture of specimens containing a constant crack length was determined between 77 and 478°K. As the temperature increased, the crack propagation mechanism changed from fast cleavage to slow cleavage propagation, and at higher temperatures to ductile cleavage propagation. The effect of temperature is discussed in terms of the blunting effect of plastic deformation. (auth)

7602 INVESTIGATION OF THE PROCESS OF HIGH-TEMPERATURE SINTERING OF TUNGSTEN. Konstantinov, V. I. Porosh. Met., Akad. Nauk Ukr. SSR, No. 10, 27-37(Oct. 1965). (In Russian).

In the process of high-temperature sintering of tungsten bars with silicoalkaline and aluminum additions and unalloyed tungsten, changes were determined in the density, porosity, chemical composition, grain size, granularity (number of grains), electric conductivity, hardness, strength, and shrinkage. It was found that the changes in the properties of the bars are interrelated. Changes in the degree and magnitude of contact between the particles, i.e. shrinkage and recrystallization were dominant. The difference in the behavior of alloyed and unalloyed tungsten during high-temperature sintering is explained by the effect of the additions, as well as by the different magnitude of the particles of the initial powder. (auth)

7603 VELOCITY OF SUBLIMATION AND DISSOCIATION OF THE BERYLLIDES OF YTTRIUM AND LANTHANUM. Amonenko, V. M.; Kruglykh, A. A.; Pavlov, V. S.; Tikhinskii, C. F. Russ. Met. Mining, No. 3, 97-8(1964).

The preparation of YBe_{13} and $LaBe_{13}$ specimens by vacuum sintering at 1180°C of their respective powders in stoichiometric proportions is described. The evaporation of the compounds from 1040 to 1290°C and determination of sublimation heat, sublimation rate and vapor pressure of Be over both beryllides was determined. (Rev. Metal Lit.)

7604 PLUTONIUM AND THE ACTINIDE METALS. Mendelssohn, Kurt (Clarendon Lab., Oxford). Sci. J., 1: 73-8(Nov. 1965).

The discovery of the transuranium elements is reviewed. Methods for preparation and handling of the actinide metals are described. Resistivities of thorium, uranium, neptunium, and plutonium were measured as a function of temperature. When the resistivity of plutonium was measured at the temperature of liquid helium, it was found that the resistivity increased with time. The effect was also found in neptunium and ^{233}U. (M.C.G.)

7605 STUDY OF OXYGEN DIFFUSION IN QUARTZ BY USING THE NUCLEAR REACTION $^{18}O(p,\alpha)^{15}N$. Choudhury, A.; Palmer, Derek W.; Amsel, G.; Curien, H.; Baruch, P. (Univ., Paris). #Solid State Commun., 3: 119-22(June 1965).

A new method is applied to the study of the diffusion of the stable isotope ^{18}O in a solid. It consists of measuring the spectrum of the α-particles produced by the nuclear reaction $^{18}O(p,\alpha)^{15}N$ when the solid is bombarded by monoenergetic protons. The α-particle spectrum is closely related to the distribution of ^{18}O atoms in the solid. By this method diffusion in crystalline quartz heated in high-pressure ^{18}O-enriched steam was studied. The results indicate that the diffusion was strongly anisotropic. At 667°C and 820 bar pressure, the diffusion coefficients were $\sim 8.10^{-14}$ cm^2/sec perpendicular to the c-axis and $\sim 4.10^{-12}$ cm^2/sec parallel to the c-axis. (auth)

7606 ON INFLUENCE OF CARBON CONTENT ON THE COBALT PHASE AND SOME MECHANICAL PROPERTIES OF WC–Co CEMENTED CARBIDES. Kubota, H.; Ishida, R.; Hara, A. Trans. Indian Inst. Metals, 17: 132-8(Sept. 1964).

Characteristics of the Co phase as related to its C content are determined by measuring the lattice parameter, Curie point, saturation magnetization, and weight loss in acid solutions. Hardness, transverse rupture strength and fatigue strength of the Co–WC cemented carbide, by changes in the Co phase, are measured. (Rev. Metal Lit.)

7607 ON THE TEMPER HARDENING PROPERTIES OF COBALT–TUNGSTEN ALLOYS. Toda, Tadatoshi (Hitachi Research Lab., Japan). Trans. Jap. Inst. Metals, 6: 139-46(July 1965).

Rods of Co–W (.0~25%) alloys were made by sintering and hot swaging. Dilatation behaviors through the $\alpha \rightleftharpoons \beta$ transformation were examined and x-ray diffraction analyses of quenched or tempered specimens were made. The temper hardening and the TTT diagram of the β-to-α transformation were measured in detail for Co–25% W alloys. The crystal structure of the Co–25% W alloy quenched from 1100°C had the fcc lattice of β phase. On tempering of the quenched specimen at 600 to 675°C, the retained β-phase transformed slowly into the hcp lattice of α-phase accompanied by an increase in hardness. The rate of transformation was apparently controlled by diffusion. The maximum Vicker's hardness value, 750, was attainable by optimum conditions of the tempering. The TTT diagram of the β-to-α transformation was determined in the Co–25% W alloy by a metallographic method. The nose of the TTT diagram was placed at about 750°C, where the beginning and the ending times of the transformation were about 700 and 10,000 sec, respectively. (auth)

7608 THE PLUTONIUM–CADMIUM BINARY SYSTEM. Etter, D. E.; Martin, D. B.; Roesch, D. L.; Hudgens, C. R.; Tucker, P. A. (Mound Lab., Miamisburg, Ohio). Trans. Met. Soc. AIME, 233: 2011-13(Nov. 1965). (MLM-1281J).

The equilibrium phase diagram of the Pu–Cd alloy is presented based on data obtained by differential thermal analysis, metallography, and electron-microprobe x-ray analysis. Liquidus temperatures range from 320 to 934°C. The alloy contains one congruently melting compound, $PuCd_2$ (945°C), and three incongruently melting compounds, $PuCd_4$ (800°C), $PuCd_6$ (730°C), and $PuCd_{11}$ (410°C). A liquid-miscibility gap extends from 2 to 60 at. % Cd with the monotectic reaction isotherm at 910°C. (auth)

7609 PRESSURE OF SATURATED VAPOUR OF LIQUID CERIUM. Kruglykh, A. A.; Pavlov, V. S. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukr. Fiz. Zh., 10: 1029-32(Sept. 1965). (In Ukrainian).

The pressure of cerium vapor was determined in the temperature range of 1295 to 1570°C. Cerium, 99.7% pure, purified by the method of zonal recrystallization was used for the measurements, which were carried out by two independent methods: by effusion and the rate of evaporation from a cylindrical crucible. The change in the weight of the container with the substance was recorded continuously. The results show good agreement and are described by the equation $\log P_{mm} = 8.81 - 19020/T$. The heat of evaporation of cerium was determined as 87.0 kcal/mole; the boiling point, as 2930°C. (auth)

7610 FERRIMAGNETIC RARE EARTH METAL–MANGANESE COMPOUNDS. [PART] I. Kirchmayr, Hans Rudolf; Schindl, Karl-Heinz (Technische Hochschule, Vienna). Z. Angew. Phys., 19: 517-21(1965). (In German).

With a magnetic balance based on the Faraday principle, suitable for small sample masses (10 to 100 mg) of strongly paramagnetic or ferromagnetic powder, compounds with the structure $REMn_5$ (RE = Y, Sm, Gd, and Ho) prepared by the amalgam method were investigated at 80 to 1400°K. Measurements were made of the magnetic transformation temperature, the temperature dependence of the magnetization, the saturation magnetization, and the magnetic susceptibility. The results established that YMn_5 is ferromagnetic, whereas $SmMn_5$, $GdMn_5$, and $HoMn_5$ showed a ferrimagnetic behavior. It was concluded that $GdMn_5$ and $HoMn_5$ in the ferrimagnetic range display two different spin-coupling states. The magnetic moments μ or the effective magnetic moments μ_{eff} determined from the separation magnetization or the susceptibility pattern are explained and discussed on the basis of the theory. (tr-auth)

7611 PROTONS IN GLASSES. NUCLEAR MAGNETIC RESONANCE AND INFRARED SPECTROSCOPIC INVESTIGATIONS OF GLASS STRUCTURE AND ON "WATER CONTENT." Mueller-Warmuth, W. (Max-Planck-Institut fuer Chemie, Mainz); Schulz, G. W.; Neuroth, N.; Meyer, F.; Deeg, E. Z. Naturforsch., 20a: 902-17(July 1965). (In German).

Nuclear magnetic ^1H and ^{29}Si resonance investigations and the variations of the OH infrared spectra were used to obtain information on the structure of protons in glasses and the adjacent structures of binary alkali silicate glasses. The line forms of the proton resonances can be explained by magnetic dipole interactions with the nuclear moments of ^7Li, ^{23}Na, ^{39}K, ^{133}Cs, ^{29}Si, ^{11}B, ^{27}Al, and ^{207}Pb. In alkali silicate glasses the adjacent structure does not change for the most part when Li^+ is replaced by Na^+, K^+, and Cs^+. In the same sequence, however, the tendency of the uptake of hydrogen present in the form H^+ ions increases. These are bound to the O^- ions, which are found at the separation sites produced by alkali ions. The magnetic resonance results are compared with a model in which two alkali ions or one alkali ion and one hydrogen ion occur as pairs at distances of about 2 Å. By comparisons with proton resonances of known polycrystalline substances the proton concentration in numerous types of glass was determined and compared with the glass composition, its preparation, and the infrared spectrum between 2 and 7 μ. It is not possible to give a universal calibration factor for any of the OH oscillations in glass with which one can calculate the proton concentration by the infrared method. Ir spectroscopic methods, therefore, can distinguish concentrations of 0.1×10^{18} protons/cm^3, whereas the sensitivity limits of proton resonances is 2×10^{18}/cm^3. (J.S.R.)

7612 ON THE CRYSTAL STRUCTURE OF SAMPLES OF THE Nb_3Sn PHASE WITH DIFFERENT TRANSITION POINT TEMPERATURES. Pfister, H. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Z. Naturforsch., 20a: 1059-61(Aug. 1965). (In German).

Samples of the Nb_3Sn phase with different compositions or transition point temperatures were investigated with x rays. Intensity measurements of the 110-superstructure reflection showed that in deviations from stoichiometry the excess Nb atoms were introduced on the Sn lattice plate. No lattice arrangement was established. (tr-auth)

7613 THE DIFFUSION OF TRITIUM IN A SILVER–LITHIUM ALLOY. Migge, H.; Wagener, K.; Zimen, K. E. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch., 20a: 1082-4(Aug. 1965). (In German).

Results of the measurement of the diffusion of the tritium produced in a reactor-irradiated Ag–Li alloy are reported. After irradiation the samples were degassed at constant temperature and at rapidly increasing temperatures (from 1

to 4°C/min.). From the measurements at constant temperature, the only deviations from the values predicted by the simple diffusion model were that precipitation was first delayed and the total gas mass released was proportional to $t^{\frac{1}{2}}$ during the first 15 to 25 min and not to $t^{\frac{1}{2}}$. The study with increasing degassing temperature showed first an increasing and then a decreasing gas rate release. The results were very similar to those obtained for the diffusion of H in pure silver in the temperature range between 388 and 600°C. (J.S.R.)

7614 CRYSTAL STRUCTURE OF TANTALUM, NIOBIUM AND VANADIUM BETWEEN 110-400 deg K. Smirnov, Yu. N.; Finkel, V. A. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksp. Teor. Fiz., 49: 1077-82(Oct. 1965). (In Russian).

The structure of tantalum, niobium, and vanadium was studied between 110 and 400°K by the x-ray diffraction method. The electric resistance was measured from 110 to 300°K. It is shown that phase transformations in Ta and Nb do not occur in the investigated temperature range. An anomaly is observed in the thermal expansion coefficient of vanadium which is of the λ-point type and the temperature of which depends on purity of the metal (200–233°K). The anomaly of the thermal expansion and electric conductivity are assumed to be due to transition of vanadium to the antiferromagnetic state. (auth)

7615 ON THE PLASTIC STRAIN MECHANISM OF MAGNESIUM–NEODYMIUM ALLOYS IN CONDITIONS OF LONG-TIME AND SHORT-TIME TENSION. Drits, M. E.; Sviderskaya, Z. A.; Rokhlin, L. L. pp 83-7 of Issled Stalei i Splavov. Moscow, Nauka, 1964. (In Russian).

Metallographic and x-ray analyses show that in heat treated (quenching from 535°C, tensile straining to 5, 10, and 18%, aging for 24 hr at 200°C) Mg–3% Nd specimens the grains become comminuted. Moreover, on aging, the Mg_9Nd crystals precipitate not only along the grain boundaries but also along the twin boundaries. The microstructure of specimens tested at 250 and 300°C in conditions of short-time and long-time fracture was investigated. Prepeened specimens had slightly more twins, but less grains with slip bands. The microstructure of specimens, which had been subjected to stress-rupture tests, had strongly coagulated Mg_9Nd-phase crystals. In specimens which had not been subjected to peening the Mg_9Nd precipitations were chiefly distributed along the grain boundaries. Moreover, the grain boundaries were serrated. In peened specimens the Mg_9Nd crystals precipitated along the grain boundaries and twin boundaries. The increase in stress-rupture strength due to thermomechanical treatment is insignificant. (Rev. Metal Lit.)

7616 INVESTIGATION OF THE STRESS-RUPTURE STRENGTH OF COLD WORKED TUNGSTEN AND ITS ALLOYS WITH MOLYBDENUM IN TEMPERATURE REGIONS ABOVE 1400 C. Ezhov, I. A.; Zakharov, E. K.; Kidin, I. N. pp 118-20 of Issled Stalei i Splavov. Moscow, Nauka, 1964. (In Russian).

Powdered-metal W and the alloy W–50 Mo were subjected to warm drawing with degrees of reduction approximately 99%. Ground specimens 160 mm long and 1 mm (W) and 0.8 mm (alloy) in dia were tested in a vacuum 10^{04} mm Hg. The specimens loaded in a cold state were heated to the testing temperature and the creep and the time before fracture were determined. Loads were selected so that the time before fracture was 1 to 100 min. It was shown by a logarithmic plot of time-before-fracture vs stress that the time before fracture is directly proportional to the stress. The surface of the specimens became rough during the test. Intercrystalline cracks, which were perpendicular to the direction of the applied load, appeared near the fracture. After 10 min of testing, the strength of the alloy was 1–4 kg/mm² lower than that of W. However, the alloy has a higher plasticity. (Rev. Metal Lit.)

7617 ON THE PROBLEM OF DETERMINING THE HEAT RESISTANCE OF SOME REFRACTORY ALLOYS FROM THEIR INTERNAL FRICTION. Aleksandrov, L. N.; Mordyuk, V. S. pp 125-31 of Issled Stalei i Splavov. Moscow, Nauka, 1964. (In Russian).

W and Mo wire of various brands were subjected to high-temperature tensile and stress relaxation tests at 1500–2500°C. The results of the investigation are given. The degree of heat resistance of W and Mo depends on the nature of the diffusion mobility of the lattice defects in the stress field. All diffusion processes shift towards higher temperatures with the increase in the heat resistance. The values for the activation energy of the vacancy movement and formation in W, increasing with the increase in the heat resistance of the specimens, are determined from the character of the temperature dependence of the internal friction background. The values for the activation energy of vacancy formation, determined from the internal friction, are in good agreement with published data. (Rev. Metal Lit.)

7618 EFFECT OF TITANIUM AND MOLYBDENUM ON THE RECRYSTALLIZATION TEMPERATURE AND STRENGTHENING OF COLUMBIUM ALLOYS. Kontorovich, I. E.; Savkina, L. Ya.; Estulin, G. V. pp 147-9 of Issled Stalei i Splavov. Moscow, Nauka, 1964. (In Russian).

The effect of separate alloying with Ti(2,5,10%) and Mo (5, 7, 10%) was investigated. The alloys were smelted in an arc furnace with a consumable electrode. The ingots were pressed at 1500–1550°C to billets 30 mm in dia, annealed for 1 hr at 1400–1600°C and cold forged to rods 15 mm in dia. Primary recrystallization takes place in Nb at 1050–1150°C, in Nb–Ti (less than 10% Ti) at 1000–1100°C, and in Nb–Mo (less than 7% Mo) at 1150–1250°C. The recrystallization in a Nb–10% Mo alloy is completed at 1300°C. The hot hardness decreases considerably at 900–950°C. An addition of 10% Mo produces maximum strengthening. At 900°C, Nb and Nb–10% Mo alloys have a hot hardness 88 to 106 R_B, and at 1400°C, a hot hardness 72 and 96 R_B, respectively. At 1000°C, σ_b of Nb increases from 20 kg/mm² to 45–50 kg/mm² in a Nb alloy with 7–10% Mo. Ti doping reduces σ_b 1000 and somewhat lowers the recrystallization temperatures. (Rev. Metal Lit.)

7619 ON THE METASTABLE POLYMORPHISM OF ALLOYS BASED ON ELEMENTS OF THE FOURTH GROUP IN THE PERIODIC TABLE. Lashko, N. F. pp 74-9 of Metalloved Titana. Moscow, Nauka, 1964. (In Russian).

Published data on metastable polymorphic transformations in Ti-, Zr-, and Hf-base alloys are analyzed. The retention of the metastable β- and ω-phases on quenching, and the stability of the beta-phase on aging, depending on the temperature of eutectoid transformation, are examined. The phase composition of Zr–Nb alloys after quenching and aging is investigated. In an alloy with 6% Nb after quenching from 800°C, a relatively stable residual β-phase, which is stable at 400°C for 2 hr and decomposes at 550°C, is formed. During quenching of an alloy with 8% Nb, an ω-phase, which is stable at 400°C for 2 hr, and at 430°C for 0.5 hr, is formed. During quenching of an alloy with 15% Nb from 800 C, a metastable β-phase, which decomposes after 2 hr at 400°C into a Nb-enriched β-phase, and into a Nb-depleted ω (β_2 + ω) phase, is formed. An alloy with 20% Nb retains the structure of a β-solid solution at 400°C for 2 hr, and at 550°C the β-solid solution decomposes. (Rev. Metal Lit.)

7620 THE TEMPERATURE DEPENDENCE OF ELECTRICAL AND GALVANOMAGNETIC PROPERTIES OF RARE-EARTH METALS. Vol'kenshtein, N. V.; Fedorov, G. V.; Galoshina, E. V.; Startsev, V. E. pp 79-85 of Vopr Teor i Prim Redkozem Met. Moscow, Nauka, 1964. (In Russian).

The electrical resistivity and Hall coefficient of rare-earth metals were measured. Electrical resistivity was measured by using the usual potentiometer technique in a metal cryostat from room temperature to 1.2°K. It was established that all metals can be divided into four groups, according to the temperature dependence of their electrical resistivity. Nd and Yb with an electrical resistivity whose dependence on temperature is not linear in the whole temperature range belong to the first group. A

discontinuity and a small maximum of electrical resistivity in the region of the transition from the paramagnetic state into the antiferromagnetic state are characteristic for the second group (Dy, Mo and Er). A sharp discontinuity on the curve for electrical resistivity (T) at the transition from the paramagnetic into the antiferromagnetic state and a very distinctly pronounced linear dependence of electrical resistivity (T) in the paramagnetic region can be observed for the third group (Gd and Tb). A drastic drop of electrical resistivity below the point of transition from the paramagnetic into the antiferromagnetic state, and a complex shape of the dependence of electrical resistivity (T) near the transition in the paramagnetic region can be observed for Eu. Using the measurements of R, the rare-earth metals can be divided into two groups: light metals, up to Gd, in which the conductivity is realized by positive carriers, and heavy metals, beginning from Gd, in which the conductivity is connected with electrons. (Rev. Metal Lit.)

7621 PHASE EQUILIBRIA STUDIES IN THE SYSTEM $MgO–Al_2O_3–ZrO_2$ [Thesis]. Baker, Robert Jethro Jr. Urbana, Ill., Univ. of Illinois, 1964. 200p.

The phase equilibria characteristics in the region of the system $MgO-Al_2O_3-ZrO_2$ bounded by the 50 mole percent and the 80 mole percent ZrO_2 isopleths were studied. Liquidus, solidus, and limited subsolidus transition temperatures were determined utilizing cooling curve analysis in an induction furnace capable of 3000°C. Liquidus temperatures in the composition region range from 1900°C to 2400°C; solidus temperatures range from 1830°C to 2135°C. An apparent subsolidus transition ranging from 1850° to 1950°C in the MgO-rich portion of the diagram was observed and is tentatively attributed to a change in the cubic zirconia solid solution from the cation interstitial type to the anion vacancy type solid solution during cooling. The high-temperature reactions that occur during the cooling of initially molten samples producing the single and multiphase eutectic regions observed in the microstructures of the compositions studied in this portion of the ternary system were characterized. These reactions can be classified as follows: a primary phase which is either tetragonal ZrO_2 or cubic zirconia solid solution crystallizing from the liquidus to the solidus temperature with a secondary eutectic phase region crystallizing at the solidus temperature; a secondary phase, crystallized at the solidus temperature, which is identical to the primary phase but not a eutectic phase; and primary eutectic phase region crystallizing at the eutectic temperature of the eutectic composition. Evaluation of the phase equilibria, the characteristic reaction modes, and the microstructure observations indicated that potentially useful commercial refractory compositions exist in the MgO-rich region of this ternary system. A comprehensive literature survey dealing with all the facets of the system $MgO-Al_2O_3-ZrO_2$ was assembled. (A.G.W.)

7622 AN INVESTIGATION OF THE ERBIUM–SELENIUM AND THE ERBIUM–TELLURIUM SYSTEMS [Thesis]. Haase, Donald James. Austin, Tex., Univ. of Texas, 1965. 112p.

All of the phases occurring in the erbium–selenium system and the erbium–tellurium system were determined. Each of the compositions in the two systems was characterized according to electronic behavior and crystalline structure. The erbium–selenium system has three distinct single phase regions, the ErSe, the $Er_2Se_3-Er_3Se_4$ solid solution series, and the compound $ErSe_2$. The erbium–tellurium system has only two distinct single phase regions, the $ErTe-Er_2Te_3$ solid solution series and the compound $ErTe_3$. ErSe is a face-centered cubic structure and the solid solutions belong to the Sc_2S_3 type structure. The polyselenide and polytelluride have orthorhombic unit cells. The electrical properties are described on the basis of two models, an extrinsic region model and an intrinsic region model. The models are tested for each composition to see if they explain the observed behavior. Each of the compositions was determined to be degenerate, with the exception of $ErSe_2$ over a small temperature range. Predictions of the electrical behavior and structural stability of other systems are made with the conclusions obtained from this investigation. (Dissertation Abstr.)

7623. THE CRYSTAL STRUCTURES OF INTERMETALLIC COMPOUNDS IN THE YTTRIUM–ZINC SYSTEM [Thesis]. Harsha, Karnmadakala S. Sree. University Park, Pa., Pennsylvania State Univ., 1964. 132p.

The structure of YZn_2 was determined by comparison with the structure of $CeCu_2$. The coordination polyhedron of the A-atom in the $CeCu_2$-type structure appears to be intermediate between those for the Laves phases and the AlB_2-type structure. The structure of YZn_3 was determined by a combination of Patterson synthesis and Fourier techniques. Spatial arguments aided in the identification of the space group for YZn_3 which was found to be Pnma. The crystal structure of YZn_3 represents a new structure type for AB_3 intermetallic compounds. Spatial arguments and Patterson maps revealed that YZn_4 belongs to the space group Immm. The method of structure invariants enabled the determination of nineteen sets of signs for twenty large structure factors of the (0kl) type, from which trial structures were postulated. All the trial structures postulated contradict the earlier postulate of the existence of the compound YZn_4. The same compound was, however, found to explain the observed results if the stoichiometry of the compound is given by Y_3Zn_{11}. The structure of YZn_4 was, therefore, determined on the basis of a change in the description of the stoichiometry of the compound. The structure of Y_3Zn_{11} found in this way represents a new structure type for A_3B_{11} compounds. Preliminary results indicate that YZn_5 is not isostructural with the common AB_5 structures, the $CaCu_5$ and UNi_5 structures. The three compounds YZn_2, YZn_3, and Y_3Zn_{11} have structures that consist of planar layers of both yttrium and zinc atoms and these atoms are close-packed together. The characteristic feature of these layers is the presence of parallel chains of yttrium atoms between which an appropriate number of zinc atoms is located. The structures of the intermetallic compounds in the yttrium–zinc system are most probably determined by packing efficiency of these layers, and the influence of directional bonding in determining these structures appears to be small. (Dissertation Abstr.)

7624 MODERN CERAMICS: SOME PRINCIPLES AND CONCEPTS. Hove, J. E.; Riley, W. C. (eds.). University of California Engineering and Physical Sciences Extension Series. New York, John Wiley and Sons, Inc., 1965. 420p. $14.50.

Some of the modern fundamentals of the science and engineering of ceramic materials are discussed and examples of new materials concepts given. Nine chapters are devoted to the fundamental and applied principles underlying the study of ceramics and five chapters give specific examples of recent engineering concepts in the areas of oxides, carbides, and graphite composites. An abbreviated compilation of property data is given in the appendix. (W.L.G.)

7625 ADVANCES IN THERMOPHYSICAL PROPERTIES AT EXTREME TEMPERATURES AND PRESSURES. THIRD SYMPOSIUM, PURDUE UNIVERSITY, LAFAYETTE, INDIANA, MARCH 22–25, 1965. Serge Gratch (Ed.). New York, The American Society of Mechanical Engineers, 1965. 340p. (CONF-650303).

Forty-three articles are included; separate abstracts were prepared for 7. Three articles on thermodynamic properties of uranium dicarbide and diuranium tricarbide, thermodynamic properties of uranium monocarbide and hypostoichiometric dicarbide, and thermal conductivity of ceramic materials to 2500°C were previously abstracted in NSA as 19: 23104, 23105, and 20: 820. The remaining 33 articles include information on: statistical mechanics; thermodynamic properties of liquids, gases, and solids; radiation; transport properties. (P.C.H.)

For abstracts of individual papers see: 7113–7118, and 7626.

7626 THE THERMAL CONDUCTIVITY OF MOLYBDENUM AT ELEVATED TEMPERATURES: INFLUENCE

OF GRAIN SIZE. Jun, C. K.; Hoch, Michael (Univ. of Cincinnati). pp 296-300 of Advances in Thermophysical Properties at Extreme Temperatures and Pressures. New York, The American Society of Mechanical Engineers, 1965.

The thermal conductivity and total emittance of various molybdenum samples were measured between 1500 and 2200°K. The thermal conductivity of two samples prepared by arc melting differ by 20 per cent, the coarser grained material having the higher conductivity. Samples prepared by powder metallurgical techniques, having the smallest grain size, have the lowest thermal conductivity. (auth)

Radiation Effects

See also CHEMISTRY — Radiation Chemistry

Refer also to abstracts 7721 and 8434.

7627 (BMI-1745, Sect. U) GAS-COOLED REACTOR PROGRAM. Keller, D. L. (Battelle Memorial Inst., Columbus, Ohio). 2p.

The irradiation stability of UO_2 in ZrO_2 in comparison to UO_2 in BeO and bulk UO_2 is discussed. (W.L.G.)

7628 (BMI-X-10146) FISSION-FRAGMENT EFFECTS IN STRUCTURAL MATERIALS. Quarterly Progress Report, July–September 1965. Jablonowski, Edward J.; Ritzman, Robert L.; DeMastry, John A. (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1965. Contract W-7405-eng-92. 7p. (EURAEC-1527). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Four-point bend tests of Zircaloy-2 and type 304 stainless steel were performed at room temperature. Strain measurements were taken from strain gage located on the tensile side of the specimen. Stress-strain curves were developed from the load-deflection data. Because the bend-test techniques and material characteristics limited measurements of plastic strain, an offset-yield-strength criterion of 0.02% was selected for mechanical-property comparison. The selected yield strengths, along with values of the proportional limit, are summarized. Scatter in the bend-test data for stainless steel tends to mask a fission-fragment effect; by averaging the values for each test condition, a slight increase in proportional limit and selected yield strength as a result of recoil impregnation will be noted. The bend-test data for Zircaloy-2 show less scatter. A fission-fragment effect, an increase for the proportional limit and selected yield strength of approximately 8 to 10% over the neutron-irradiated material, was noted. The bend-test data reported are equivalent and in good agreement with mechanical-property data taken from standard tensile tests. (auth)

7629 (BNWL-150, pp 2.1-6) IRRADIATION BEHAVIOR OF CERAMIC FUELS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Microstructure and fractography studies of UO_2 irradiated in the range of 10^{15} to 10^{19} fissions/cm^3 at 100°C revealed a growing prominence of grain boundaries and an increasing number of orange peel type structures with radiation dosage. One specimen exhibited a substantially greater irregular porosity, particularly near grain boundaries, while maintaining a density similar to other specimens. The study of the time dependency of the lattice expansion of plutonium carbides and oxides due to self radiation damage was continued. (W.L.G.)

7630 (BNWL-153) EFFECTS OF NEUTRON IRRADIATION UPON THE MECHANICAL PROPERTIES OF INCONEL 625. Claudson, T. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1965. Contract AT(45-1)-1830. 20p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Results of measurements of the effects of fast neutron irradiation, test temperature, irradiation temperature, and material condition on the mechanical properties of Inconel 625 are reported. (W.L.G.)

7631 (BNWL-SA-332) A SURVEY OF METHODS FOR REPORTING NEUTRON IRRADIATION DATA. Yoshikawa, H. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1965. Contract AT(45-1)-1830. 9p. (CONF-651040-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From IAEA Panel on In-Pile Neutron Fluence Measurements, Vienna.

A survey is presented of recent proposed conventions for reporting fluence measurements for radiation effect studies. The basis for each convention and some of the implications of the analyses are described. (M.O.W.)

7632 (GA-6679) A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS. Quarterly Progress Report, May 1–July 31, 1965. Trozera, T. A.; Chambers, R. H. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Aug. 31, 1965. Contract AT(04-3)-167. 15p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Results of measurements of the isochronal recovery of fast neutron-irradiated W single crystals are presented. Progress in the study of dislocation dynamics in bcc transition metals is reported. (W.L.G.)

7633 (TID-22479) INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION. Progress Report. Sears, W. C. (Georgia Univ., Athens. Dept. of Physics). Sept. 8, 1965. Contract AT(40-1)-2418. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Studies were made on changes in molecular structure produced by high-energy radiation on different organic polymers and to determine the mechanisms of radioinduced growth and decay of unsaturation and changes in polymer crystallinity, crosslinking, and scission. The structural changes were determined by measuring the spectra of polymer films before and after irradiation. The polymers exposed to gamma irradiation were: Neoprene, polyethylene, polybutadiene, polyurethan, and olefins. (P.C.H.)

7634 (WAPD-TM-514) CYGRO-STRESS ANALYSIS OF THE GROWTH OF CONCENTRIC CYLINDERS. Friedrich, C. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Oct. 1965. Contract AT-11-1-GEN-14. 34p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The digital computer program CYGRO determines stresses and strains in two concentric cylinders undergoing thermal strains and irradiation growth, where elastic, plastic, and creep parameters are given as functions of temperature and flux level. Volume growth, flux level, power level, gas pressure between cylinders, external pressure, and water temperature are given as functions of time. At the beginning of each time step, the steady state temperature distribution is calculated and used to determine material properties. (auth)

7635 OPTICAL RADIATION STABILITY OF QUARTZ GLASS IRRADIATED WITH GAMMA RAYS AT VARIOUS TEMPERATURES. Brekhovskikh, S. M.; Landa, L. M.; Viktorova, Yu. N.; Shelyubskii, V. I. Dokl. Akad. Nauk SSSR, 163: 164-5(July 1, 1965). (In Russian).

The effect of temperature on the radio-induced discoloration of quartz glasses KI and KRL was studied. The optical radiation stability (ORS) of the glass specimens was studied at room temperature. The ratio of the light transmission of the irradiated glass to the initial transmission in the visible part of the spectrum (P_c), which is characteristic for ORS, was determined for different radiation doses. The ORS at low temperatures is also shown. The transmission was measured 10 sec, 60 min, and 24 hr after taking the specimens out of the Dewar vessel; the results remained constant. In the case of KI glass, the effect of temperature was perceived visually: specimens irradiated at room temperature were black-violet, and those irradiated at 90°K were light-smoky. The observed dependence of the discoloration on the temperature of irradiation can be explained by the shift of the dynamic equilibrium between the formed and decaying color centers. It was assumed that the number of F-centers formed decreased with decreasing temperature, while the radiation destruction of these centers did not depend on the temperature. The constant P_c after low doses

of irradiation can be explained by a decrease in the effect of radiation annealing due to the diminishing number of color centers and an increase in their stability. (CFSTI)

7636 RADIATION AND THE STRAIN IN POLYTETRAFLUOROETHYLENE FABRICATED BY COMPRESSION. Iida, Shozo (Government Ind. Res. Inst. Nagoya, Japan). Fusso Kagaku, No. 5, 3-8, 16(Mar. 1965). (In Japanese).

Polytetrafluoroethylene (PTFE) articles fabricated by compression have stress inside; this stress is gradually relaxed with deformation of the articles. When the article with inner stress is irradiated by high-energy radiation, chemical relaxation may be expected as a result of the scission of the stress-bearing polymer chains. In order to confirm this expected effect, stress relaxation curves were determined for various dose rates of ^{60}Co γ rays. The half time, i.e., the time required for the stress to become half the initial value, was only 15 minutes at 0.3 mR/hr, while it was about 24 hr without irradiation. When a fabricated article is taken out of the mold, an instantaneous recovery of the dimensions by elasticity is observed, followed by the gradual recovery by stress relaxation. These recoveries in the dimensions were decreased by irradiating the articles compressed in their mold. The gradual recovery of the dimensions or deformation by stress relaxation was decreased by irradiating the articles outside the mold with 0.3 mR of γ rays. The degree of crystallization of irradiated PTFE, calculated from the apparent density, increased as the radiation dose increased. This is a phenomenon related to the decrease of the average molecular weight of PTFE, which also leads to decrease of the porosity due to the lowering of the melt viscosity. (NSA of Japan)

7637 INJECTION-STIMULATED VACANCY REORDERING IN p-TYPE SILICON AT 76 deg K. Gregory, B. L. (Sandia Lab., Albuquerque, N. Mex.). J. Appl. Phys., 36: 3765-9(Dec. 1965).

Electron injection into p-type silicon at 76°K was observed to reduce the lifetime degradation rate due to ^{60}Co gamma irradiation at 76°K. By comparing isochronal annealing data between 76 and 300°K with similar data obtained by Watkins in EPR studies, the lifetime degradation at 76°K is seen to be due primarily to recombination through vacancies. Since the activation energy of motion of silicon vacancies is known to depend strongly on charge state, the injection-stimulated reduction in degradation rate at 76°K was related to vacancy reordering which occurs when the injected electron density is sufficiently large to modify the vacancy charge state from neutral (mobile above 160°K) to negative (mobile above 60°K). Quantitative estimates of the vacancy-reordering rate in the presence of excess electrons show that this model is consistent with the observed phenomena. (auth)

7638 ELECTRON-HOLE PAIR CREATION IN GALLIUM PHOSPHIDE BY α PARTICLES. Goldstein, Bernard (RCA Labs., Princeton, N. J.). J. Appl. Phys., 36: 3853-6 (Dec. 1965).

The energy required to form one hole–electron pair in gallium phosphide was measured to be 7.8 ± 0.8 ev/pair. The experimental method consisted of determining the charge produced and collected when α particles of known energy bombarded a surface barrier which had been formed by evaporating a thin layer of gold onto an etched surface of the gallium phosphide. When high-resistivity gallium phosphide (produced by copper diffusion) was used, the α detection efficiency dropped very sharply but could be restored to almost unity efficiency by illumination. This effect is attributed to the action of traps on the charge collection process. (auth)

7639 IRRADIATION EFFECT ON THE TENSILE PROPERTIES OF MAGNOX AL80. Nagasaki, Ryukichi; Shiraishi, Kensuke (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol (Tokyo), 2: 416-21(Oct. 1965).

A study has been made on the effect of neutron irradiation on the tensile properties at room temperature of Magnox AL80, Mg–Al alloy and unalloyed magnesium as a function of grain size. Heated treated wire specimens were encapsulated and then irradiated in the JRR-2 reactor up to exposures of 1.2×10^{19} nvt (epi-Cd energy). As a result the parameters σ_0 and k in the Petch relationship increased in magnitude after irradiations exceeding 1×10^{17} nvt. Among the materials tested Magnox AL80 was found to be the most sensitive to neutron irradiation and unalloyed magnesium the least affected. The effect of neutron irradiation on the strain rate ($\dot{\epsilon}$) dependence of the tensile stress (σ) was also investigated. The effect of neutron irradiation was to increase A and to decrease B in the equation $\sigma = A + B \log \dot{\epsilon}$, when σ represented the yield stresses. (auth)

7640 A STUDY OF THE FRICTIONAL AND WEAR PROPERTIES OF γ-RAY IRRADIATED HIGH POLYMERS. THE WEAR AND FRICTIONAL PROPERTIES AT SLIDING SPEED OF 30 cm/sec. Matsubara, Kiyoshi; Watanabe, Makoto. Junkatsu, 10: 94-100(Mar. 1965). (In Japanese).

The frictional properties of several kinds of high polymers irradiated by γ rays studied over a temperature range of from room temperature to 200°C were reported previously. The wear properties of an irradiated high-density polyethylene selected because of good reproducible data in the previous experiments was tested at a sliding speed of 30 cm/sec. In the case of a load of 10 kg/cm^2, the relation between the wear amount W and the radiation dose R can be expressed as $W \propto R$ below a critical radiation dose. It is known that the percentage of crosslinking C increases with increasing radiation dose ($C \propto R$). Thus it can be expected generally that the wear of irradiated polyethylene increases linearly with increasing radiation dose because this material becomes brittle as a result of crosslinking of molecules. On the other hand, good wear resistance was produced above the critical radiation dose when the temperature of the sliding surface reached its melting point. It was found that a factor in determining the critical radiation dose is the temperature produced on the sliding surface. When the temperature is lower than the melting point, the wear resistance deteriorates, and, inversely, when the temperature exceeds the melting point, good wear resistance is produced. Moreover, both wear states cannot occur at the same time, so that one of them is exhibited preferentially on the surface. (auth)

7641 MECHANISM OF STORED-ENERGY RELEASE AT 200 deg C IN ELECTRON-IRRADIATED GRAPHITE. Mitchell, E. W. J.; Taylor, M. R. (Univ. of Reading, Eng.). Nature, 208: 638-41(Nov. 13, 1965).

Measurements were made of the energy release in electron-irradiated graphite to determine whether the 200°C peak is present and, if the peak is found, to determine the energy involved per original displacement event. Stored energy released between 20 and 400°C varied from 1.9 ± 0.2 to 6.8 ± 0.1 cal g^{-1} with increasing electron dose. The slope of the best line of energy versus defect concentration gave a mean value of 13.5 ev per original displacement. There was an energy release peak at 200°C. The total energy released in the peak was 3.0 or per incident 2.0-Mev neutron. The energy released corresponded to 13.5 ev per displaced atom. (M.C.G.)

7642 EVALUATION OF HIGHLY IRRADIATED YANKEE FUEL CLADDING. Smalley, W. R. (Westinghouse Electric Corp., Pittsburgh). Nucl. Appl., 1: 419-24 (Oct. 1965).

Type-348 stainless-steel fuel cladding removed from Yankee Cores I and II was evaluated to confirm its acceptability and to determine its irradiation stability. Visual and metallographic examination revealed that the surface condition of the irradiated fuel rods was excellent, with no evidence of corrosion, cracks, or other cladding defects. The microstructure of the cladding was essentially unchanged as a result of reactor exposure. Although the cladding showed marked increases in hardness and strength, the remaining ductility was demonstrated to be adequate. It was concluded that the type-348 cladding performed acceptably during operation in Yankee Cores I and II and that it was capable of higher irradiation exposure. (auth)

7643 RADIATION EFFECTS ON THE MECHANICAL PROPERTIES AND MICROSTRUCTURE OF TYPE-304 STAINLESS STEEL. Armijo, J. S.; Low, J. R.; Wolff, U. E. (General Electric Co., Pleasanton, Calif.). Nucl. Appl., 1: 462-77(Oct. 1965).

The mechanical properties and microstructures of type-304 stainless steel were studied as a function of cold work, neutron irradiation, and testing temperature. True-stress, true-strain tensile tests were made on nonirradiated specimens at 70 (21), 600 (315), and 1300°F (700°C), and on irradiated specimens at 70 and 600°F. Specimens were irradiated to 1.25×10^{20} n/cm^2 (>1 Mev) at 110°F (43°C). Neutron irradiation increased the yield strength and ultimate tensile strength of annealed and cold-worked specimens at 70 and 600°F. The incremental increase in these properties decreased with increasing cold work. The elongation of nonirradiated and irradiated specimens tested at 70°F was found to increase with initial levels of cold work and then to decrease. This effect was not observed at 600°F. The most severe decreases in mechanical stability were observed in heavily deformed (greater than 20% reduction in thickness) and irradiated specimens tested at 600°F. These specimens failed in a ductile manner with total elongations as low as ½%. The increases in strength and decreases in plastic stability produced by irradiation were combined by measuring the energy absorbed to plastic instability (area under the true-stress, true-strain curve up to the point of maximum load). This energy value was found to be an effective method for comparing the effects of the various variables. Cold work was found to produce large amounts of austenite-to-martensite transformation. Neutron irradiation was found to produce no measurable increase in martensite content. Transmission electron microscopy of irradiated specimens confirmed the presence of martensite and epsilon phases in type-304 stainless steel. Irradiated specimens contained high concentrations of black dots, which were not observed in nonirradiated specimens. In some instances these black dots could be resolved into loops. These black dots are presumed to be clusters of vacancies or interstitials produced by neutron radiation. (auth)

7644 INFLUENCE OF PREIRRADIATION HEAT TREATMENT ON THE POSTIRRADIATION DUCTILITY OF STAINLESS STEEL. Martin, W. R.; Weir, J. R. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 1: 478-83 (Oct. 1965). (ORNL-P-940).

The ductility of irradiated structural alloys and some of the parameters affecting such ductility were studied. Type-304 stainless steel was investigated up to 600°C. In general, the ductility of stainless steel, solution annealed prior to irradiation, was better than steel cold worked prior to irradiation. One exception to this generality occurred under the conditions of irradiation followed by straining at 200°C, where low ductility was observed for irradiated stainless steel, solution annealed prior to irradiation. Cold working followed by carbide precipitation at an intermediate temperature improved the ductility of irradiated stainless steel at 200°C. (auth)

7645 DIRECT OBSERVATIONS OF ION DAMAGE IN GERMANIUM. Bacchilega, A.; Gondi, P.; Missiroli, G. F. (Univ., Bologna). Nuovo Cimento (10), 40B: 309-13 (Nov. 11, 1965).

Observations of ion damage and successive annealing were carried out on Ge directly inside the electron microscope. The spot-like defects in the just damaged samples resulted, after annealing, in two types of structures depending on the initial irradiation dose. To check the nature of some defects, quench-anneal tests were carried out. Both interstitial and vacancy-type defects were found. (auth)

7646 A RATE CONTROLLING MECHANISM FOR SLIP IN NEUTRON IRRADIATED COPPER SINGLE CRYSTALS. Koppenaal, T. J. (Argonne National Lab., Ill.); Arsenault, R. J. Phil. Mag. (8), 12: 951-61(Nov. 1965).

The stress dependence of the activation energy, H, and the activation volume, v*, for slip in neutron irradiated (8×10^{18} nvt) copper single crystals was determined by tensile and creep measurements using the Conrad and Wiedersich relations. The experimental stress dependences of both H and v* were in excellent agreement with those predicted by Fleischer's theory for strengthening by tetragonal distortions. A number of different correlations indicated that slip in these irradiated crystals was regulated by a single rate-controlling mechanism. The activation energy for slip was found to be temperature independent. The value of this activation energy at zero effective stress was 3.0 ± 0.5 ev. It was concluded that the rate-controlling mechanism for slip in these crystals is that given by Fleischer's theory. The tetragonality producing the strengthening is thought to arise from the small vacancy loops found in room temperature irradiated copper. (auth)

7647 EFFECTS OF IONIZING IRRADIATIONS ON THE PROPERTIES OF OXIDE-COVERED SILICON SURFACES. Kooi, E. Philips Res. Rep., 20: 595-619(Oct. 1965).

The influence of ionizing irradiations on the surface properties of oxidized silicon is measured by observing changes in the conductance of inversion layers, present at the surface of p-type silicon. In a number of cases high-frequency capacitance versus voltage measurements of MOS structures are also employed. From both kinds of measurements it is concluded that in addition to an effect on the charge distribution in the oxide-silicon system also new centers may form at the surface during irradiation. The latter effect is found to be most pronounced in samples which had been prepared in a wet ambient. In these cases the n-type character of the surface often tends to disappear during continued irradiation. Certain possible relations between the structure of SiO_2 and the irradiation effects are discussed. (auth)

7648 LOW TEMPERATURE THERMAL CONDUCTIVITY OF GERMANIUM AND SILICON IRRADIATED WITH FAST NEUTRONS. Vandevyver, M.; Albany, H. J. (Centre d'Etudes Nucleaires, Saclay, France). Phys. Lett., 19: 376-8(Nov. 15, 1965). (In French).

The thermal conductivity of monocrystalline germanium and silicon irradiated at 30°C by fission neutrons was measured between 5 and 300°K by the absolute method. The germanium and silicon used were initially of the N type with respective resistivities of 0.10 and 0.35 Ω cm. The results shown are relative to two fluxes of 1.1 $(10)^{17}$ and 2.5 $(10)^{17}$ neutrons/cm^2. From a comparison of the curves for each element, it is evident that the displacement of the maximum in the thermal conductivity toward high temperatures when irradiated relative to the position of the maximum when not irradiated is very pronounced in the case of germanium. Such a displacement is not seen in the case of silicon. Diffusion is suggested as the cause of the thermal conductivity variation with neutron flux. (J.F.P.)

7649 THE SPACE ENVIRONMENT AND ITS EFFECTS. Borson, E. N.; McClelland, J. D. (Aerospace Corp., El Segundo, Calif.). pp 397-422 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

The effects of the space environment on ceramic materials are discussed. The effects of the atmosphere, thermal environment, radiation environment, and the meteoroid environment are considered. Friction and wear, evaporation, radiation effects, and meteoroid collisions with the space vehicle are discussed. (61 references) (F.J.H.)

7650 RADIATION AND TEMPERATURE INFLUENCES ON THE ELECTRICAL CONDUCTIVITY OF ALUMINA [Thesis]. Dau, Gary John. Tucson, Ariz., Univ. of Arizona, 1965. 99p.

A program was undertaken to determine the effects of a high-level radiation field and high temperature on the electric conductivity of alumina using a nuclear reactor as a radiation source. The temperature range investigated was from 300 to 1300°K at gamma dose rates up to 5×10^6 R per hour. An in-core vacuum system was designed and

constructed. The system permitted irradiation of test elements at high temperatures in the TRIGA reactor. Results were obtained for test elements consisting of flame-sprayed alumina with its inherent impurities and were compared with results for alpha alumina (Lucalox). A theoretical development relating the conductivity due to gamma dose rate and temperature is presented. The development predicts a functional behavior of the form $\sigma_t = P(\text{constant}) \exp(-W/kT)(T)^{\frac{1}{2}}$. For polycrystalline alumina, experimental results determined W = 0.086 ± 0.014 ev and the constant = $7.4 \times (10)^{-21}$ (ohm^{-1} cm^{-1} K$^{-\frac{1}{2}}$R^{-1} hr) when the gamma dose rate, P, is in R/hr. Extrapolated results for conductivity of alumina in a gamma dose rate of 5×10^8 R/hr are also included. Transient measurements made while the reactor was increasing in power indicated that conductivity changed linearly with radiation field intensity. Measurements made immediately after the reactor became subcritical demonstrated that gamma photons were the primary factor in the increased conductivity. Radiation does change the conductivity of alumina at low temperatures; however, as the temperature increases the radiation effect decreases. At sufficiently high temperatures, the change in conductivity caused by radiation at a gamma dose rate of 5×10^8 R/hr becomes insignificant when compared to the ionic conductivity. (Dissertation Abstr.)

7651 THE INFLUENCE OF SPONTANEOUS RECOMBINATION OF FRENKEL PAIRS ON THE LATTICE DEFECT STRUCTURE IN IRRADIATED METALS [Thesis]. Lueck, G. J. Munich, Tech. Univ., 1964. 90p. $2.00 Gmelin, AED-DISS. 64-579.

Mechanisms of Frenkel pair recombination for various defect concentrations are studied. Temperature dependence for Au, Cu, and Ni is investigated. The first part of the dose curve is very sensitive to cold deformations. (Gmelin Inst.)

7652 STORED ENERGY RELEASE IN ELECTRON IRRADIATED GERMANIUM [Thesis]. Singh, Mahendra Pal. Lafayette, Ind., Purdue Univ., 1964. 74p.

Measurements are made of the release of stored energy during the annealing of degenerate n- and p-type germanium following 1.0-Mev electron irradiation. The irradiations are made at specimen temperatures less than 15°K and the specimens are annealed from 15°K up to 77°K. Results for two degenerate n-type and one degenerate p-type germanium specimens irradiated to an integrated flux of approximately 10^{17} electrons/cm^2 are presented. For n-type germanium, the time rate of release of energy as a function of temperature shows two principal annealing stages, one centered near 38°K, the other near 65°K. There is evidence of other annealing stages at 42°, 52°, 70°, and 73°K. For p-type germanium, irradiated under the same conditions, no measurable energy release is found in the range 30°–77°K. After irradiation with 10^{17} electrons/cm^2, the total energy released is 1.2×10^{-2} Joules/gram. Combining this result with each of two possible estimates of the number of vacancy-interstitial pairs determined from the annealing of electrical properties, two values of the formation energy of a Frenkel pair are obtained. They are (a) 4.7 ev (b) 8.5 ev. The interpretation of the two principal stages in the stored energy release of n-type germanium is that the recovery is due to recombination of two different configurations of close-spaced vacancy-interstitial pairs. The conclusion from the evident immunity of p-type germanium to radiation damage at low temperatures is that the defects in p-type germanium are unstable at the irradiation temperature. (Dissertation Abstr.)

7653 EFFECTS OF SIMULATED SOLAR-WIND BOMBARDMENT ON SPACECRAFT THERMAL CONTROL SURFACES. Jorgenson, G. V. (Litton Systems, Inc., Minneapolis). New York, American Inst. of Aeronautics and Astronautics, 1965, Preprint No. AIAA 65-647, 11p., $1.00. (CONF-650955-2). ORINS.

From American Inst. of Aeronautics and Astronautics, Thermophysics Specialist Conference, Monterey, Calif.

Several thermal control surfaces were subjected to simulated solar-wind bombardment in hydrogen and helium plasmas with bombardment doses that simulated times of the order of 1–100 yrs in space at one astronomical unit. The solar spectral reflectance and the thermal emittance were measured before and after bombardment. Bombardment causes an increase in the solar absorptance but no measurable change in thermal emittance. Data are presented as plots of bombardment damage vs bombardment dose. Some materials show large amounts of damage for low bombardment doses (up to 20% decrease in total solar reflectance for $\sim 2 \times 10^{16}$ H_2^+/cm^2). Damage vs bombardment dose for several different ions (Ne^+, Ar^+, Xe^+) was also studied. The severity of the bombardment damage is found to be related to the depth of ion penetration. Some thermal control coatings, which are least affected by ultraviolet radiation, are found to be the most susceptible to solar-wind bombardment damage. (auth)

7654 EXPLORATORY TRAPPED-PARTICLE AND TRAPPED-PARTICLE-PLUS-ULTRAVIOLET EFFECTS ON THE OPTICAL PROPERTIES OF SPACECRAFT THERMAL CONTROL COATINGS. Breuch, Ronald A. (Lockheed Missiles and Space Co., Palo Alto, Calif.). New York, American Institute of Aeronautics and Astronautics, 1965, Preprint No. AIAA 65-646, 22p., $1.00. (CONF-650955-1). ORINS.

From American Inst. of Aeronautics and Astronautics, Thermophysics Specialist Conference, Monterey, Calif.

Thermal control coatings were exposed in vacuum at controlled temperatures to simulated geomagnetically trapped high-energy electron and low-energy proton environments. Coatings were also exposed concurrently to high-energy electron, ultraviolet, and simultaneous high-energy electron-plus-ultraviolet environments. The parameters for the combined environmental test included a calculated mean electron energy of 0.80 Mev and a total flux of 6×10^{14} e$^-$/cm^2 and 436 equivalent sun hours ultraviolet (2000 to 4000 Å). Test parameters for the low energy proton tests included a mean energy of 130 kev and total integrated fluxes from 2×10^{14} to 4×10^{15} protons/cm^2. Samples were maintained at room-temperature during the exposures and the test chamber pressure was $<10^{-6}$ mm-Hg. Optical damage spectra for the materials tested are reported and mechanical damage is discussed. Possible extraneous effects of vacuum system contamination were monitored in each test and no test sample contamination was noted. Materials exposed to a low-energy proton environment were damaged severaly ($\Delta\alpha_s > 100\%$) after exposure to an apparent threshold of 10^{15} protons/cm^2. Synergistic effects of engineering importance were evident in the combined electron-plus-ultraviolet tests. The space radiation environment is summarized to indicate the regions of application for the results of the ground-based environment tests. (auth)

7655 EFFECTS OF PROTONS AND ALPHA PARTICLES ON THERMAL PROPERTIES OF SPACECRAFT AND SOLAR CONCENTRATOR COATINGS. Gillette, R. B.; Brown, R. R.; Seiler, R. F.; Sheldon, W. R. (Boeing Co., Seattle). New York, American Inst. of Aeronautics and Astronautics, 1965, Preprint No. AIAA 65-649, 41p., $1.00. (CONF-650955-4). ORINS.

From American Inst. of Aeronautics and Astronautics, Thermophysics Specialist Conference, Monterey, Calif.

Studies were conducted to determine the effects of protons and alpha particles on thermal and solar concentrator coatings. In addition a study was made of the solar particle radiation environment expected for a 230-day Earth-to-Mars mission. Included are descriptions of the radiation test facilities, the types of specimens investigated, the changes observed in their surface reflectivities, and a comparison of charged particle effects as a function of particle type and energy. The particle energies used in the tests were 1- to 9-kev and 2.5-Mev protons, and 2- to 16-kev and 5.0-Mev alpha particles. The space radiation environment was evaluated to determine appropriate particle exposures for charged particle tests. A 230-day Mars flight was chosen as a representative space mission. Estimated fluences of protons and alpha particles for this mission are presented. Particle fluences were based on recent studies of solar cycle 19, along with data from

Mariner II, Lunik II, and Explorer X. A solar wind simulator was used to produce the kev-energy protons and alpha particles. The solar wind simulator uses hydrogen or helium gas that is ionized by an 80-Mc RF oscillator and then electrostatically accelerated to the desired kev energy. Mass, energy, and charge separation of ions is accomplished by means of limiting apertures and a solenoid bending field. This arrangement results in a uniform charged particle beam of approximately 1-inch diameter at the sample position. A Dynamitron accelerator was used to produce energetic protons and alpha particles for these tests. Mass-one hydrogen and doubly ionized helium were separated from ionized hydrogen and helium beans respectively by the use of a 90-degree, mass-energy-product-16 bending magnet. These particles were then scattered from thin gold foil to provide uniform sample exposure. Test specimens included barrier-layer anodic-coated aluminum, zinc oxide/potassium silicate paint (Z-93), zinc oxide/LTV-602 paint (S-13), chemically brightened high-purity aluminum, and vapor-deposited aluminum on aluminum. Typical effects observed were yellowing of the paints, interference absorption in the anodic-coated aluminum, and blistering of the unprotected aluminum specimens. (auth)

7656 IRRADIATION METHOD. Inoue, Kiyoshi (to Hitachi, Ltd.). Japanese Patent 1964-18498. Aug. 31, 1964. Filed Dec. 11, 1962.

The irradiation method proposed is used in the irradiation of high polymers for the improvement of their qualities. The polymers are irradiated in the form of films whose thicknesses are so chosen that the sum of the whole thickness to be irradiated is less than or near the mean flight path of the electron beam. The film is irradiated in the transverse direction by an electron beam of uniform current density, and the rate of movement of each film can be adjusted. Calculation of the absorbed radiation dose is described. (TCO)

PHYSICS

General

Refer also to abstract 6695.

7657 (IAE-933) MATEMATICHESKIE OSNOVANIYA MEKHANIKI RAZRYVNOGO IMPUL'SA. (Mathematical Fundamentals of the Mechanics of an Interrupted Pulse). Feinberg, S. M. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 80p. Dep. mn.

Classical mechanics discusses the problem of a material point which follows a continuous trajectory in time, q(t), assuming that this function has a derivative everywhere. Newton's dynamics also assumes that there is a second derivative, proportional to the force, which determines the shape of the motion. Surprisingly, this naive concept was retained even after Kantor, although at that time it became obvious that a continuous function cannot have a second derivative; twice-differentiated functions represent a limited subclass of the continuous functions. It was proposed to generalize the concept of the trajectory of the material point, examining the mechanics of a point moving along a continuous trajectory of a discontinuous pulse. This trajectory q(t) has nearly everywhere a first derivative p(t) = mq(t) but p(t) is a discontinuous function of time; thus the Newtonian forces do not act and the rules of classical mechanics do not apply. This problem is considered at length, examining the role of Heisenberg's uncertainty principle in the statistical interpretation of the mechanics of the microcosmos. Finally, other abstract mechanics of motion are considered. (TTT)

7658 (JINR-P-2396) O RASPROSTRANENII SIGNALOV VYSOKOI CHASTOTY V SREDE SO SLUCHAINYMI KHARAKHTERISTIKAMI. (On Propagation of High Frequency Signals in Medium with Random Characteristics). Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 10p. Dep. mn.

Solutions of the second order linear equation with random coefficients for high frequency signal (the geometric optics approximation) are treated. (auth)

7659 (ORNL-3849, pp 101-50) RADIATION PHYSICS. Hurst, G. S. (Oak Ridge National Lab., Tenn.).

Research and development programs concerned with radiation physics are described. Investigations of radiation interactions with gases and solids are also described. Results of investigations concerning radioinduced tissue damage are included. (J.R.D.)

7660 GENERATION OF HARMONICS OF THE ELECTRON GYROMAGNETIC HALF-FREQUENCY IN A DOUBLE-BEAM SYSTEM. Olivain, Jack; Etievant, Claude; Perulli, Mariano (EURATOM-CEA, Fontenay-aux-Roses, France). Compt. Rend., 261: 3310-13(Oct. 27, 1965). (In French).

The experimental study of the spectrum of the oscillation frequencies produced in the collision of two electron beams penetrating each other parallel to a magnetic field revealed the existence of harmonics of the electron gyromagnetic half-frequency. The frequency, amplitude, and width of these rays were studied. (tr-auth)

7661 THE ROLE OF THE DIFFUSION OF INVERTED POPULATION IN THE GENERATION OF INDUCED RADIATION. Livshits, B. L.; Tsikunov, V. N. (Inst. of High-Pressure Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSR, 162: 314-15(May 11, 1965). (In Russian).

In the theory of the generation of induced radiation in multimode generators the spatial inhomogeneity of the radiation field within the resonator, and thus, the inhomogeneity of the inverted population in the specimen, is not usually taken into account. This leaves in doubt the diffusion velocity of the inverted population. This problem was analyzed, assuming that the excitation diffusion takes place through a chain of active centers, placed at a distance R between neighboring centers, whereby $R \ll \lambda$; λ designates the wavelength of the radiation that determines the linear dimensions of the inhomogeneity of the inverted population. Equations were derived for the process of generating induced radiation in a plane resonator model, considering only the axial mode. The results obtained apply to media with a homogeneous broadening of the luminescence lines of the active centers. (TTT)

7662 LOW ENERGY ION SOURCE IN A MAGNETIC FIELD. Tsuchimoto, T. (Hitachi Ltd., Tokyo). Nucl. Instrum. Methods, 37: 135-40(Nov. 1965).

A low energy ion source of hydrogen ions in a magnetic field is developed, and a modified acceleration-deceleration potential method is used. The beam energy of this ion source is below 400 ev and its intensity is about 700 μA. The atomic ratio of the ion beam is 67% maximum. Pulsed ion beams are also generated. (auth)

7663 ON THE EXACT EVOLUTION OF THE DISTRIBUTION FUNCTIONS. Biel, J.; Garrido, L. M. (Univ. of Barcelona). Nuovo Cimento (10), 40B: 197-212(Nov. 11, 1965).

A manageable method to study the exact evolution of the distribution functions is presented. The development of the method is based on the techniques of projection operators (Zwanzig's method) and on an idea of Andrews. With this method a unified view for every kind of classical system with finite-range interactions is obtained. The momentum distribution function of a homogeneous system and the one-particle reduced distribution function of an inhomogeneous system are both studied in a general manner, in the case of free systems as in the case of systems subjected to external stationary fields. For these distribution functions the same (in form) evolution equations are set up. Thus, the problem of the exact equations for inhomogeneous systems in an external stationary field is easily resolved. Finally, a method for calculating exact expressions for the density in phase space and for the reduced distribution functions in every kind of system in terms of the distribution functions studied is obtained. (auth)

7664 ON THE EVOLUTION OF SYSTEMS WITH FINITE-RANGE INTERACTIONS. Biel, J. (Univ. of Barcelona). Nuovo Cimento (10), 40B: 213-23(Nov. 11, 1965).

A connection between the intuitive idea of finite-range interactions and the evolution equations for systems having only this kind of interaction is established. A different treatment from that made in a preceding paper is presented; but the new method is equivalent to the first one. Moreover, some intuitive arguments are given to see that the evolution equations obtained previously for homogeneous as well as inhomogeneous systems subjected or not to external stationary fields are exact. It is verified that the solution of Zwanzig's equations for any distribution function does not depend on the projection operators employed to select this distribution function from the density in phase space. The choice of the projection operators in this method is also justified. (auth)

7665 INVESTIGATION OF SPACED MAGNETIC FOCUSING OF EXTENDED ELECTRON FLUXES TAKING INTO ACCOUNT THE RADIAL AND NONSINUSOIDAL AXIAL DISTRIBUTION OF THE FOCUSING FIELD. Kasatkin, L. V.; Danovich, I. A. Radiotekhn. Elektron., 10: 1684-91(Sept. 1965). (In Russian).

In systems of periodic magnetic focusing, designed for the production of intense beams, the axial distribution of the magnetic fields can be distinguished from the sinusoidal distribution. These are the sites of significant changes of

induction in the transverse cross section of the beam. Taking into account the real distribution of the magnetic field in the focusing system, the original differential equation describing the trajectory of boundary electrons was derived. The solution of the equation was made on the computer URAL-2. From the analysis of the solution obtained, the optimum regimes and the range of stability of focusing for different parameters of the axial and radial distribution of the magnetic field were determined. It was shown that the calculation of the real distribution of the field leads to an essential change of the zone of stability and conditions of optimum focusing of the electron beam. (tr-auth)

7666 NEUTRALIZATION OF SPHERICALLY DIVERGING FLUXES OF CHARGED PARTICLES. Levin, V. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 3, 68-70(May-June 1965). (In Russian).

Problems of the neutralization of a spherically diverging flux of ions are considered. The ions (assumed singly charged) are emitted from an electrode of radius r^0 at a potential Φ_0 and pass through an accelerating screen of radius r_0 at zero potential. There is then a neutralizing screen of radius r_* at a potential Φ_* which is assumed to be an ideal emitter of charged particles of opposite sign. The equations for the potential outside the neutralizing screen are rewritten in terms of the parameters $\Phi = (\phi - \Phi_*/\Phi_0 - \Phi_*)$, $r = r_* e^s$. It is found that the behavior of the solution depends on the value of the parameter $\lambda^2 = (2A(1+\alpha^2)^{\frac{1}{2}}/\alpha^2)$ where $\alpha = (J/J_1)(\sqrt{m}/\sqrt{M})$, $A = (J_1\sqrt{Me}/\sqrt{2}(\Phi_0 - \Phi_*)^{\frac{1}{2}})$, M and J_1 are the mass and total flux of the ions, m and J are the mass and total flux of the neutralizing particles, and e is the electronic charge. For $\lambda^2 \leq 1$ ϕ increases monotonically from zero to the limiting value $\phi_\infty = \alpha^2 (1+\alpha^2)^{-1}$. For $\lambda^2 > 1$ ϕ undergoes damped oscillations about the same limiting value with increasing s. Asymptotic formulas for the behavior of the potential are given for large and small values of the parameter s. The particular case of the neutralization of a cesium beam is considered. It is shown that, if the neutralization is by electrons, the potential is of the damped oscillating form. However, if the neutralization is by negative ions beginning with hydrogen ions, the potential is of the monotonically increasing form. (ATD)

7667 CLASSICAL DYNAMICS OF PARTICLES AND SYSTEMS. Marion, Jerry B. New York, Academic Press, 1965. 588p. $11.50.

The classical mechanics of particles, systems of particles, and rigid bodies is presented. Topics covered include matrices and vectors, vector calculus, the fundamentals of Newtonian mechanics, the special theory of relativity, gravitational attraction and potentials, oscillatory motion, nonlinear oscillations, and methods in the calculus of variations. Other topics are Hamilton's principle—lagrangian and hamiltonian dynamics, central-force motion, the kinematics of two-particle collisions, motion in a noninertial reference frame, dynamics of rigid bodies, systems with many degrees of freedom—small oscillations and normal coordinates, and the wave equation in one dimension. (J.F.P.)

7668 METHOD FOR IRRADIATING A GAS. Oshima, Yunosuke (to Hitachi, Ltd.). Japanese Patent 1964-18497. Aug. 31, 1964. Filed Feb. 14, 1962.

The method proposed provides an efficient irradiation of a gas in its container. The container for the gas to be irradiated is irradiated from outside by highly penetrating x rays. Part or all of the container wall is made of a substance of high atomic number. Upon irradiation of this substance, electrons are produced; the gas within the container is irradiated by these electrons. (NSA of Japan)

Accelerators

Refer also to abstracts 7803 and 8062.

7669 (BNL-9663) HEALTH PHYSICS ASPECTS OF INSTALLATION AND TESTING OF A 3-Mev 10-mA ELECTRON ACCELERATOR. O'Brien, Michael J. (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT(30-2)-Gen-16. 13p. (CONF-651109-11). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 1st Symposium on Accelerator Radiation Dosimetry and Experience, Upton, N. Y.

A brief description of the Dynamitron electron accelerator is presented. Shielding considerations in the design of the accelerator and health physics aspects of operation are discussed. (M.O.W.)

7670 (INFN/TC-64/5) DISPOSITIVO AUTOMATICO DI STABILIZZAZIONE DELLA TENSIONE PER UN ACCELERATORE TIPO VAN DE GRAAFF. (Automatic Device for Stabilization of Voltage for a Van de Graaff Type of Accelerator). Bocciolini, M.; Di Caporiacco, G. (Istituto Nazionale di Fisica Nucleare, Florence (Italy)). June 26, 1964. 9p. Dep. mn.

The operational principle is based on the control of the charge across a feedback device in which the output voltage is compared with a variable reference standard. The device incorporates the possibility of preselection of any voltage level up to 500 kv with 0.5% precision, and optimum uniformity of loads during level variations. The energy dispersion of the beam is less than 1 kev. The operation is partially automated. The response time is approximately 0.5 sec. In cases in which this response time is not adequate, the method can also furnish a versatile pre-stabilization. (tr-auth)

7671 (JINR-P-2387) BYSTRYI VYVOD PUCHKA PROTONOV IZ SINKHROFAZOTRONA JINR (FIZICHESKIE OSNOVY). (Fast Ejection of Proton Beam from the JINR Synchrophasotron (Physical Principles)). Zinovev, L. P.; Issinskii, I. B.; Kotov, V. I.; Kulakova, E. M.; Myznikov, K. P.; Paviov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 80p. Dep. mn.

A calculation is made of a system that provides an ejection of about 80% of the circulating beam from the JINR synchrophasotron for less than 100 μsec. The system consists of a magnet-deflector, with which the beam is extracted from the synchrophasotron chamber, and of a device for exciting the half-integer parametric resonance of betatron radial oscillations, by means of which the accelerated particles are introduced into the deflector gap. A detailed theoretical and experimental investigation is carried out of particle motion in the synchrophasotron when the parametric resonance is excited. Some specific features are analyzed of the beam motion in the deflector, in the edge field of the accelerator. Requirements for ejection elements are formulated. The ion-optical system of the extracted beam transport to the measurement area is calculated. (auth)

7672 (JINR-P-2408) KOMPENSATSIYA DISPERSII PUCHKA V MAGNINYKH OTKLONYAYUSHCHIKH SISTEMAKH. (Compensation of Beam Dispersion in Deflection Systems). Kladnitskii, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 14p. Dep. mn.

Afocal deflection systems consisting of two and three sector magnets with uniform fields are considered. Such systems deflect the incident parallel beam at a finite angle leaving particle trajectories in parallel. To analyze the ion-optical properties use is made of the matrix method. From the transfer matrices obtained one can deduce the afocal conditions in energy. Formulas are given for determining the position of the energy focus in the general case when the deflection system is not afocal. (auth)

7673 (JINR-P-2424) NEKOTORYE KHARAKTERISTIKI PUCHKA NEITRONOV, OBRAZUYUSHCHIKHSYA PRI VZAIMODEISTVII PROTONOV S KINETICHESKOI ENERGIEI 9 Gev S MISHENYU IZ Be NA SINKHROFAZOTRONE JINR. (Some Characteristics of a Beam of Neutrons Produced by 9 Gev Proton Interaction with Be Target at the JINR Synchrophasotron). Zernin, Yu. D.; Moroz, V. I.;

Nikitin, V. A.; Sviridov, V. A.; Troyan, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 8p. Dep. mn.

Using NIKFI-R emulsions, the mean energy and angular distribution of the neutron beam produced by the interaction of 9-Bev protons with Be are measured in the angle interval 0 to 6° of the lab. system. At 0° the average energy of neutrons is found to be 6.6 ± 0.7 Bev. (auth)

7674 (LA-DC-7318) SHIELDING CONSIDERATIONS FOR THE PROPOSED LOS ALAMOS MESON PHYSICS FACILITY. Cochran, D. R. F.; Israel, H. I. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 19p. (CONF-651101-48). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 13th Conference on Remote Systems Technology, Washington, D. C.

Los Alamos Meson Physics Facility is an 800-Mev, 1-ma-average proton linac, designed for production of intense pion beams. Design criteria involving shielding and residual radioactivity at this linac are reviewed. The general aspects of the facility are discussed, as well as an outline of the accident analyses carried out. (T.F.H.)

7675 (MPS-INT.LIN-62-5) LES PANNES DU GENERATEUR 600 kV HAEFELY DU LINAC. SURVENUES LE 31.10.1961 ET LE 7.4.1962 ET LEUR REPAPATION. DESCRIPTION ET COMMENTAIRES. (Breakdowns of the 600 Kv Haefely Generator of the Linac. Incidents of Oct. 31, 1961 and July 4, 1962 and their Repairs. Description and Comments). Huguenin, Jean (European Organization for Nuclear Research, Geneva (Switzerland)). Nov. 19, 1962. 32p. Dep. mn.

The breakdowns are described. The probable origin of the breakdowns (weakness of the HV protection circuits, non-functioning of the safety valves, and errors during repair) are identified. The measures taken to increase the reliability are described. These include reinforcement of the internal insulation of the generator, improvement of the HV protection resistance, improvement of the primary and secondary safety valves, and institution of routine controls. The generator tests and the routine controls are analyzed. (J.S.R.)

7676 (PPAD-567D) MALFUNCTION ALARM SYSTEM FOR ACCELERATOR CONTROLS. Cheeseman, P. R. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Sept. 1, 1965. Contract AT(30-1)-2137. 34p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The development of a series of memory alarm devices used in the control system of the Princeton 3-Bev accelerator is described. It consists of solid state circuitry for the memory-alarm in combination with relay contact logic for control. Great flexibility is made possible by the plug-in construction of the units and by standardized wiring of the chassis. Thus, interchangeable use of the units allows a choice of alarm sequences with little or no rewiring. Its use as an integral part of a control system is discussed. Also described is a fabricated assembly allowing quick connection to experimental equipment for monitoring faults. Circuit description and diagrams are included. (auth)

7677 (SLAC-50) CONSOLIDATION OF RESULTS OF PRELIMINARY BEAM TESTS WITH SECTORS 1 AND 2. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Sept. 1965. Contract AT(04-3)-400. 98p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The results of beam tests on sectors 1 and 2 of the two-mile linear accelerator are presented. Separate discussions are presented for klystron performance, operation of the phasing system, typical energy spectra, klystron energy contribution, recycling and replacement, beam dynamics, guidance, and transmission, beam measurements of coupler asymmetry and girder alignment, and the over-all system operation. (M.O.W.)

7678 (SLAC-51) POISSON EQUATION SOLVING PROGRAM. Herrmannsfeldt, Wm. B. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Sept. 1965. Contract AT(04-3)-400. 33p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The general characteristics of a pair of computer programs designed to solve applications of Poisson's equation are given. The programs are specifically written to solve electron trajectories in electrostatic focusing systems and to solve for magnetic fields. The programs could be adapted to other applications such as heat transfer problems. (auth)

7679 (UJV-1386/65) STABILISATOR DER DE-FLEKTORSPANNUNG. (Stabilizer of the Deflector Voltage). Fukatko, T. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). July 1965. 10p. Dep. mn.

A stabilizer of the deflection voltage of a cyclotron was described. It is characterized by relatively simple construction with a stabilization accuracy of 5×10^{-3}. In the installation of the stabilizer no connections are necessary in the power supply installation of the deflector. (tr-auth)

7680 (AEC-tr-6660) STATUS REPORT ON ELECTRON STORAGE RING VEP-1. Budker, G. I.; Kushnirenko, E. A.; Naumov, A. A.; Cauchin, A. P.; Popov, S. G.; Sidorov, V. A.; Skrinsky, A. N.; Tumaikin, G. I. Translation of Paper Presented to the International Conference on High Energy Accelerators, Frascati, Italy, September 3-14, 1965. 13p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf.

VEP-1 is composed of two coupled high-vacuum synchrotron-type magnetic rings, and associated beam-transport and detection systems. Electron beam storage up to 130 Mev is described. Colliding-beam measurements on electron-electron scattering at 40 to 90° are described. (T.F.H.)

7681 (AEC-tr-6664) THE BEAM CONTROL SYSTEM OF THE ELECTRON STORAGE RING VEP-1. Zinin, E. T.; Korobeynikov, L. S.; Kulipanov, G. N.; Lazarenko, B. L.; Matveev, Ju. G.; Popov, S. G.; Skrinsky, A. N.; Starodubtseva, T. P.; Tumaikin, G. M. Translation of Paper Presented to the International Conference on High Energy Accelerators at Frascati, Italy, September 3-14, 1965. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf.

Beam control systems, beam parameters, and instrumentation at the 130-Mev VEP-1 colliding-electron-beam facility are outlined. (T.F.H.)

7682 EXTERNAL PROTON BEAMS AT THE PS. Reich, K. H. CERN Cour., 5: 148-58(Oct. 1965).

A new system for ejecting the high-energy proton beam from the accelerator has recently come into use for the East experimental area of CERN's proton synchrotron. A discussion is given on why external beams are desirable and two main systems used for providing them are distinguished: single-turn ejection and multiturn ejection. The principles of the particular type of multiturn ejection known as resonant ejection, devised and developed at CERN and now put into operation, are then explained in some detail, followed by a description of the installation, illustrated by a diagram of the layout and photographs. Finally, indications are given of the developments to be expected at CERN both in the provision of more external beams and in the sharing of the accelerated protons between internal and external targets. (auth)

7683 LENS CHARACTERISTICS FOR ELECTRODE SYSTEMS USED IN ACCELERATION TUBES. Koltay, E.; Czegledy, S. (Inst. of Nuclear Research, Debrecen, Hungary). Nucl. Instrum. Methods, 37: 179-80(Nov. 1965).

Graphs summarizing the ion-optical parameters for electrode gaps having cylindrical lens shields, which are normally used in cascade-type current generators for heavy ions, are presented. Two lens shield configurations are treated. (T.F.H.)

7684 APPARATUS FOR IRRADIATING WITH AN ELECTRON BEAM. Adachi, Takeshi (to Tokyo Shi-

baura Electric Co., Ltd.). Japanese Patent 1964-19140 Sept. 7, 1964. Filed Oct. 28, 1963.

The apparatus described is equipped with a rotatable piping arrangement for passing the beam suitably onto the object to be irradiated. The apparatus consists of the main body of an accelerator, an electron-beam producing device mounted on the main body, and a rotatable means mounted on both the object to be irradiated and the electron beam-producing device. The rotatable means adjusts the width of the irradiation field according to the size of the object to be irradiated. (NSA of Japan)

7685 ELECTRON BEAM APPARATUS. Kimura, Hiroichi (to Hitachi, Ltd.). Japanese Patent 1964-19780. Sept. 12, 1964. Filed Oct. 2, 1962.

The acceleration of electrons is achieved by using alternating voltage. The proposed apparatus includes an electron gun, which consists of a cathode filament, a controlling cylinder, an anode, and an electric focusing lens system for focusing the beam. The arrangement of the proposed electron gun includes connecting the anode to the ground, applying the alternating voltage for accelerating electrons to the filament or a controlling cylinder having the same or slightly different potential from that of the filament, and focusing the beam independently of the accelerating voltage to a predetermined point via the focusing lens system. (NSA of Japan)

Astrophysics and Cosmology

Refer also to abstracts 7747, 7759, 7966, 7969, and 7990.

7686 CHEMICAL EVIDENCE BEARING ON THE ORIGIN OF THE SOLAR SYSTEM. Suess, Hans E. (Univ. of California, San Diego, La Jolla). Ann. Rev. Astron. Astrophys., 3: 217-34(1965).

Evidence and considerations that might ultimately provide a consistent picture of the early history of the solar system and of the processes that led to the formation of the planetary objects are illustrated. The chemical composition of primordial matter, the oxidation-reduction state of planetary matter, parent bodies of planets and meteorites, and the cosmochemical fractionation processes are discussed. The most important conclusion to be derived from the evidence presented is considered to be that processes primarily responsible for variations in the chemical composition of planetary objects were those that led to a separation of gases from condensed matter. Diffusive separation of gases from each other was probably not important; and magnetic separation of condensed phases were responsible only for special phenomena such as the separation of metallic nickel-iron from the rest of the material and the formation of certain types of achondrites. (J.F.P.)

7687 COSMIC MAGNETOBREMSSTRAHLUNG (SYNCHROTRON RADIATION). Ginzburg, V. L.; Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow). Ann. Rev. Astron. Astrophys., 3: 297-350(1965).

A discussion is presented on magnetobremsstrahlung or synchrotron radiation from an electron moving in a plasma, rather than in a vacuum, since the plasma is essential in many instances, such as discrete sources of cosmic radio emission, the solar corona, etc. The discussion is limited to an analysis of the theory of magnetobremsstrahlung and to a few of its applications in astrophysics. Certain results obtained from lengthy calculations are stated without proof, but the reference is cited for the details of the calculation. Magnetobremsstrahlung from individual electrons and from ensembles of electrons, the influence of cosmic plasmas on the propagation and emission of electromagnetic waves, and some applications of the theory of magnetobremsstrahlung in astrophysics are considered. (J.F.P.)

7688 MULTIPLE FALL OF PRIBRAM METEORITES PHOTOGRAPHED. 10. ^{22}Na AND ^{26}Al RADIOACTIVITIES IN THE PRIBRAM AND ITS RELATION TO METEORITE ORBITS. Fireman, E. L. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). Bull. Astron. Inst. Czech., 16: 291-2(1965).

The ^{22}Na and ^{26}Al contents of Pribram were measured to be 126 ± 16 dpm/kg and 63 ± 5 dpm/kg. These values are compared with ^{22}Na and ^{26}Al contents of other recently fallen meteorites. While the ^{22}Na content of Pribram is higher than in Harleton, it is not significantly higher than that in Hamlet, Bruderheim, or Peace River. The $^{22}Na/^{26}Al$ ratio gives the cosmic-ray flux near the aphelion of the orbit prior to the fall compared to the flux integrated over a long time. The results indicate that the orbit of the Harleton meteorite has a smaller aphelion than that of Pribram and of Peace River. (auth)

7689 POSSIBLE EFFECT OF THE INCLINED INTERPLANETARY MAGNETIC FIELD ON THE SHAPE OF THE OUTER CORONA AND SUPERCORONA. Krivsky, L.; Letfus, V. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 16: 319-20(1965).

It is demonstrated that the deflection of the paths of particles by the galactic magnetic field under the ecliptic plane also applies to flares with ejection of particles that produce PCA (radio cosmic noise polar cap absorption) effects about the terrestrial poles. The case of an extraordinarily enhanced radio emission when the radio source Taurus A was occulted by a supercorona at the distance of about 45 solar radii is analyzed. The results lead to the conclusion that the effect of the intensity and of the direction of the inclined interplanetary magnetic field most probably affects the shape of the supercorona identified by radio measurements and that this tilt will also have to be considered in supercorona models. There may be a similar effect on the corona. (J.F.P.)

7690 NUCLEAR REACTIONS IN METEORITES. Surkov, Yu. A.; Nazarkina, G. B. (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 8, 918-35(Aug. 1965). (In Russian).

Some problems in the determination of cosmogenic isotopes formed in meteorites under the action of cosmic rays are discussed. The similarities and differences of nuclear reactions occurring in cosmic space and in accelerators are considered. The possibility of determining the contents of cosmogenic isotopes in meteorites was established. (auth)

7691 OLBERS' PARADOX AND THE BACKGROUND RADIATION DENSITY IN AN ISOTROPIC HOMOGENEOUS UNIVERSE. Harrison, E. R. Mon. Notic. Roy. Astron. Soc., 131: 1-12(1965).

The background radiation density in an isotropic homogeneous universe is determined using a differential equation approach rather than the usual integral equation method. For the class of models obeying $R \propto t^n$ it is found for $n > -1$ that the radiation density is $E = \epsilon\rho t/(n+1)$ after sufficient time has elapsed following the initial conditions. In this equation ρ is the density of luminous matter (the stars) and ϵ is the rate radiation energy produced per unit time per unit mass of luminous matter. (In the static model considered by Olbers, $n = 0$ and t is the time for which the stars have emitted radiation; in the steady-state model $n = \frac{1}{3}$ and $t = \frac{1}{3} T_0$ where T_0^{-1} is Hubble's constant.) Olbers' paradox is that the sky is dark at night, whereas in an infinite universe the sky should be as bright as the surface of a star. But in a static universe the stars must radiate for $t \sim 10^{23}$ years in order that the radiation level is raised to that at the surface of the stars. However, radiation from the stars at the present rate for such a vast period of time violates the conservation of energy principle. It is shown that Olbers' original assumptions account satisfactorily for the present radiation level provided the stars have only a finite radiation lifetime of $t \sim 10^{10}$ years. In any model of an isotropic homogeneous universe of $n > -1$ the background radiation level is less than the average radiation level at the surface of the stars when $t < (n+1)\tau$ where τ is the "mean collision time" of a photon between emission and absorption. The

present value of τ is of the order 10^{23} years. The expansion ($n > 0$) or contraction ($n < 0$) of the universe has surprisingly little effect on the present radiation level. Thermodynamic arguments are used to estimate the present mean density of luminous matter and this is compared with the total density deduced from general relativity theory for simple models. (auth)

7692 EMISSION OF NEUTRINO-PAIRS FROM A STELLAR PLASMA. Zaidi, M. H. (Brandeis Univ., Waltham, Mass.). Nuovo Cimento (10), 40A: 502-5 (Nov. 21, 1965).

The emission of neutrino pairs by a stellar plasma is calculated. The expressions for longitudinal and transverse emissivities differ from the corresponding expressions of Adams, Ruderman, and Woo by factors of $\frac{3}{8}$ and $\frac{1}{4}$, respectively. (auth)

7693 TRANSIENT BEHAVIOR OF A HEATED STELLAR ATMOSPHERE. Bird, G. A. (Univ. of Sydney). Phys. Fluids, 8: 2289-91(Dec. 1965).

The results of a numerical investigation of the unsteady flow which follows the sudden application of heating to a static atmosphere are presented. The rate of heat addition did not depend directly on time but was related, in various ways, to the instantaneous thermodynamic properties of the heated region. The major purpose of the investigation was to determine whether the steady state always results or if, under some circumstances, a pulsating flow occurs. The method of characteristics was used for the investigation. (C.E.S.)

7694 COSMIC-RAY-PRODUCED XENON IN METEORITES. Rowe, M. W.; Bogard, D. D.; Brothers, C. E.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). Phys. Rev. Lett., 15: 843-5(Nov. 29, 1965).

It was found that xenon extracted from a series of achondritic meteorites is heavily enriched in xenon-124, -126, and -128. Experimental data are reported which give strong support to the view that the excess amounts of these light isotopes of xenon are cosmic-ray produced. The concentrations of excess xenon isotopes are given for some meteorites. The amounts of excess xenon-124, -126, and -128 are plotted against the cosmic-ray exposure age, and the effective cross section for the production of these xenon isotopes from spallation of barium by cosmic rays are given. Since meteorites were chosen with a wide range of cosmic-ray exposure, a wide range of barium concentrations, and a varied amount or primordial xenon, the relatively small variation from the average value of the effective cross sections for the studied xenon isotopes obtained is considered rather firm evidence for the mechanism of cosmic-ray spallation during the past 2 to 50 million years. (J.F.P.)

7695 RADIATION SINTERING OF LUNAR DUST. Smoluchowski, R. (Princeton Univ., N. J.). Science, 150: 1025-6(Nov. 19, 1965).

Protons in the solar wind displace atoms in the grains of lunar dust. These atoms may, through diffusion, sinter the dust layer into a partly coherent but still highly porous structure. (auth)

7696 THE ROLE OF ACTIVE REGIONS IN THE FORMATION OF QUASISTATIONARY CORPUSCULAR STREAMS FROM THE SUN. Mustel, E. R. (Astronomical Council, Academy of Sciences, USSR). Soviet Astron. AJ (Engl. Transl.), 9: 375-86(Nov.-Dec. 1965).

Translated from Astron. Zh., 42: 473-87(May-June 1965).

A comparative, critical analysis of two existing hypotheses is presented. The first holds quasistationary corpuscular streams of solar corpuscles to originate in the most active region; according to the second hypothesis, the "cone of avoidance" hypothesis, active regions only deflect those solar-wind corpuscles which are moving from adjacent unperturbed solar regions. The latest data available on cosmic rays of solar origin as well as extra-atmospheric data on the velocities and magnetic fields of the solar plasma were used in the analysis. It is shown that all of these data provide complete confirmation of the first hypothesis (the active region hypothesis). Three aspects of the "cone of avoidance" hypothesis are discussed (statistics, general properties of the perturbed geomagnetic field, and physical properties of corpuscular streams), and it is demonstrated that all available data, including cosmic radiation data and space probe data, contradict the "cone of avoidance" hypothesis. (auth)

7697 ORIENTATION OF ATOMS AND MOLECULES BY RESONANCE RADIATION IN COSMIC SPACE. Varshalovich, D. A. (Ioffe Inst. of Applied Physics, Academy of Sciences, USSR). Soviet Astron. AJ (Engl. Transl.), 9: 442-50(Nov.-Dec. 1965).

Translated from Astron. Zh., 42: 557-67(May-June 1965).

The spins of molecules, atoms, and ions in an irradiated rarefied gas will become oriented if the angular distribution of the incident radiation is anisotropic. The mechanism for the spin orientation induced by resonance radiation and its time variation are considered. The conditions necessary for dynamical orientation and the properties of a medium whose particles are at least partially oriented are discussed. In some cases, allowance for orientation will significantly alter the density as estimated from the passage of resonance radiation. (auth)

7698 STUDY OF THE SPECTRA OF DISCRETE SOURCES OF COSMIC RADIO-EMISSION AT FREQUENCIES BELOW 40 Mc/sec. Bazelyan, L. L.; Braude, S. Ya.; Vaisberg, V. V.; Krymkin, V. V.; Men, A. V.; Sodin, L. G. (Inst. of Radiophysics and Electronics, Academy of Sciences, Ukrainian SSR). Soviet Astron. AJ (Engl. Transl.), 9: 471-9(Nov.-Dec. 1965).

Translated from Astron. Zh., 42: 618-28(May-June 1965).

Measurements of the spectra of 18 discrete sources in the range 20–38 Mc/sec were carried out. They show that the spectra of 13 sources follow a power law with an exponent similar to the spectra in the range 38–1400–3200 Mc/sec. For three sources (3C 274-Vir A, 3C 405-Cyg A, and 3C 461-Cas A) the spectrum exhibits a "valley," i.e., a change in the spectral law amounting to a decrease in the flux density at frequencies below 20–25 Mc/sec. For the sources 3C 84a and 3C 166, a break in the spectrum was found, an increase in the flux density in comparison with higher frequencies. Possible mechanisms giving rise to the change in the spectrum in the decameter range are discussed. (auth)

7699 THE RADIO SOURCE 3C 386—A SUPERNOVA REMNANT? Pskovskii, Yu. (Shternberg Astronomical Inst., USSR). Soviet Astron. AJ(Engl. Transl.), 9: 526-7 (Nov.-Dec. 1965).

Translated from Astron. Zh., 42: 683-4(May-June 1965).

The results are reported of a comparison of the distance, brightness, age, dispersal rates, absolute visual magnitude and other characteristics of the radio source 3C 386 and the 3C 144. The agreement in the absolute magnitudes of the 1054 and 1230 outbursts and in the dispersal rates of the remnants implies that 3C 386 is a younger (by 176 yr) analog of M1. (L.B.S.)

7700 RELATIVISTIC ASTROPHYSICS. [PART] II. Zel'dovich, Ya. B.; Novikov, I. D. Usp. Fiz. Nauk, 86: 447-536(July 1965). (In Russian).

Most of the current questions of astronomy have been formulated but not all of them have been answered. The chief problem arose in connection with the discovery of a novel type of heavenly bodies, the superstars or quasars. The currently accepted theory of the constitution of the stars agrees with the observed facts and explains satisfactorily the distribution of temperature and density within the Sun and similar stars which possess a reserve of hydrogen. The ultimate state of these stars must be arrived at theoretically by assuming that all the nuclear fuel has been used—otherwise the nuclear reaction would be continued, and that the temperature reached zero—otherwise more energy would be emitted. It was attempted to determine the conditions of a mechanical equilibrium.

For stars with a mass less than 1.2 times the mass of the Sun($M_\odot$), the equilibrium state is reached when the electron shell of the atoms is destroyed but the nuclei are sufficiently far from each other, so that the electron gas pressure may counteract the gravitational forces (white dwarfs). If the mass of the star is $>1.2 \times M_\odot$ but less than the critical mass $M_{crit} \cong 2M_\odot$, the equilibrium state represents a neutron star. The matter is compressed to about the density of the nucleus, or 10^{14} g/cm^3; the radius of the star is about 10 km and the potential of the gravity forces is about 0.2 c^2. Under these conditions, the effect of Einstein's general theory of relativity on the gravitational forces must be considered. The maximum critical mass is predicted by that theory and no answer is available for cases larger than it; in view of the "slowing down" of time, a remote observer notes an asymptotic approach to the "congealed" state. These problems were examined in greater detail, considering also the problem of collapse and the theory of anticollapse. (152 references) (TTT)

7701 LITHIUM AND CALCIUM PRODUCED BY COSMIC RADIATION IN IRON METEORITES. Hintenberger, H.; Voshage, H.; Sarkar, H. (Max-Planck-Institut fuer Chemie, Mainz). Z. Naturforsch., 20a: 965-7(July 1965). (In German).

The lithium and calcium concentration of a sample of the Trenton iron meteorite was measured by thermionic detection methods. The time pattern of the $^7Li/^6Li$ ratios during the heating of the sample was determined and showed that, after the lithium supply of the sample was almost exhausted and the ion current after each temperature increase fell to smaller values after an initial intensity increase, there was a slight increase of the $^7Li/^6Li$ ratios to values of approximately 2. It was shown that the $^7Li/^6Li$ ratio for pure cosmogenic lithium is approximately 1.2 ± 0.2. Meteoritic calcium could also be observed with an isotopic frequency significantly different from that of the frequencies of terrestrial calcium. It was calculated that the cosmogenic fraction of the meteoritic ^{42}Ca was 40%, of ^{43}Ca was 78%, of ^{44}Ca was 18%, and of ^{46}Ca was 87%. (J.S.R.)

7702 LANDOLT-BOERNSTEIN. Numerical Data and Functional Relationships in Science and Technology. New Series. Group VI: Astronomy . Astrophysics and Space Research. Volume I: Astronomy and Astrophysics. Hellwege, K. H.; Voigt, H. H. (eds.). Berlin; Heidelberg; New York; Springer-Verlag, 1965. 750p. DM 314.--.

Numerical data and functional relations are presented for astronomy. This presentation includes data for astronomical instruments, astronomical constants for position and time determination, abundances of elements in the universe, the solar system, the stars, special types of stars, and star clusters and associations. Also data for the stellar system, and for galaxies are included. (J.F.P.)

7703 17.5 Mev PHOTOFISSION OF ^{238}U [Thesis]. Meason, John Lesly. Little Rock, Ark., Univ. of Arkansas, 1965. 116p.

Fission of ^{238}U induced by 17.5-Mev photons was studied, and the cumulative mass yields were measured by radiochemical techniques. The yields determined were $0.24 \pm 0.04\%$ for A = 83, $0.66 \pm 0.12\%$ for A = 84, $4.3 \pm 0.9\%$ for A = 91, $4.4 \pm 0.9\%$ for A = 92, $5.6 \pm 1.0\%$ for A = 99, $2.2 \pm 0.5\%$ for A = 131, $7.8 \pm 2.2\%$ for A = 132, $5.5 \pm 1.0\%$ for A = 133, $5.7 \pm 1.0\%$ for A = 134, $2.6 \pm 0.5\%$ for A = 135, $4.9 \pm 0.8\%$ for A = 139, and 6.00% for A = 140. Reasonable agreement was noted between the above data and the yields reported by other investigators for maximum bremsstrahlung energies of 16, 18, and 21 Mev. Effects generally noted in the mass-yield curves for other fission reactions were observed. Fine structure was indicated in the mass region A = 131-135 for 17.5-Mev photon-induced fission, in which the spike seems to be located at A = 132. Attempts to explain the fine structure by the method proposed by Pappas account qualitatively for the observed fine structure. A rough calculation of the gamma-ray flux in the solar irradiation process at the time of the formation of the meteorites and the earth was made from the differences in the terrestrial and meteoritic xenon isotope abundance data, assuming that the photofission of uranium was responsible for the excess heavy xenon isotopes in certain meteorites and in the earth's atmosphere. The results of this calculation indicate that a gamma-ray flux of 1.5×10^7 γ/cm^2/sec over a 10^7 year period was necessary to produce the excess ^{136}Xe observed for the Fayetteville meteorite. This corresponds to a total production of 10^{21} gamma-rays during the irradiation period. Three sources of low-energy gamma-rays are proposed; (1) the ^7Li (p,γ) $2He^4$ reaction, (2) the ^{19}F (p,$\alpha\gamma$)^{16}O reaction, and (3) thermal neutron capture gamma-rays. Solar flares are the source of protons in the reactions (1) and (2) and proton spallation reactions produce the neutrons required for reaction (3). (Dissertation Abstr.)

7704 STELLAR STRUCTURE. Aller, Lawrence H.; McLaughlin, Dean B. (eds.). Stars and Stellar Systems. Compendium of Astronomy and Astrophysics. Volume VIII. Chicago, The University of Chicago Press, 1965. 668p. $17.50.

The book included 11 chapters. Separate abstracts were prepared for each. (J.F.P.)

For abstracts of individual chapters see: 7705—7715.

7705 THE ORIGIN OF THE CHEMICAL ELEMENTS. Bashkin, Stanley (State Univ. of Iowa, Iowa City). pp. 1-112 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

A summary and comparison is given of nuclear astrophysics in recent years. The various viewpoints are emphasized in order to clarify speculative and well-understood material. Topics discussed are nuclear abundances, the problem of the nuclei of deuterium, helium-3, lithium, beryllium, and boron; and various astronomical objects are considered. The various attempts that have been made to explain the composition of the sun and the solar system are considered. (J.F.P.)

7706 STELLAR ENERGY SOURCES. Reeves, Hubert (Univ. of Montreal). pp. 113-93 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

Stellar evolution is briefly sketched, and a review is given of the problem of nuclear energy generation rates during stellar evolution. The set of nuclear reactions involved in hydrogen burning is discussed in detail. The helium-burning reaction, and subsequent burning stages are discussed. Various modes of neutrino emission are considered in the late stages of stellar evolution. Finally, a number of nuclear reactions are considered, which are of interest especially for studies of nucleosynthesis. (J.F.P.)

7707 STELLAR ABSORPTION COEFFICIENTS AND OPACITIES. Cox, Arthur N. (Los Alamos Scientific Lab., N. Mex.). pp. 195-267 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

A review is given of the conditions in stellar interiors and atmospheres, the derivation of the radiation diffusion flux formula, the use of opacities for stellar interiors, and radiation transfer in stellar atmospheres. Then the absorption coefficient and opacity data are summarized. The absorption and scattering processes and electron conduction are considered. Methods of opacity calculations, new results, and the use of opacities are discussed. It is noted that while many features of absorption calculations still require attention, such as energy-level calculations, bound-bound absorption, and plasma effects, reasonably accurate opacities are now available over the entire range of temperature and density needed in studies of stellar structure. (J.F.P.)

7708 STELLAR MODELS FOR MAIN-SEQUENCE STARS AND SUBDWARFS. Stroemgren, Bengt (Inst. for Advanced Study, Princeton, N. J.). pp. 269-95 of

Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

The results of numerical calculations of evolutionary model sequences for main-sequence stars are presented. Non-rotating, spherically symmetrical stars are considered. It is assumed that the effects of magnetic fields are negligible, and that mass losses and gains through interaction with the surroundings are vanishingly small. Main sequence stars with masses larger than 1.7 M⊙ are discussed. For stars in the mass range 0.8 to 1.7 M⊙, the presence of a deep outer convection zone complicates this discussion. For the discussions of stars in both mass ranges, limitation is made to models representing stars of initial chemical compositions that do not differ strongly from the initial solar composition. Stars of relatively low heavy-element content, that is the extreme population II stars are also discussed. For stars of masses under 0.8 M⊙, discussion is limited to homogeneous hydrogen-burning models. (J.F.P.)

7709 THE THEORY OF WHITE DWARFS. Mestel, L. (Cambridge Univ., England). pp. 297-325 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

In the discussion of zero-temperature stars, the pressure of the degenerate, perfect electron gas, corrections to the perfect gas model, the restrictions on composition imposed by nuclear physics, and non-spherical stars are covered. White dwarfs of finite temperature are discussed including the internal temperature, a white dwarf as a cooling body, and nuclear energy generation and stability. The origin and evolution of white dwarfs are also considered. (J.F.P.)

7710 THEORY OF NOVAE AND SUPERNOVAE. Schatzman, E. (Institut d'Astrophysique, Paris). pp. 327-65 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

The theory of the origin of outbursts and of the observed changes in the structure of a star is considered. The novas, including recurrent and dwarf novas, and supernovas are considered separately. In each case a short historical summary of the theories is given. It is pointed out that the theories of novas and supernovas are still largely speculative. (J.F.P.)

7711 SUPERNOVAE. Zwicky, F. (Carnegie Inst. of Washington, Cold Spring Harbor, N. Y. California Inst. of Tech., Pasadena). pp. 367-423 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

A review of supernovas is presented. The historical background is given. The frequencies of supernovas is considered. Statistics as related to phenomenological characteristics of supernovas and of galaxies in which they appear are discussed. Finally, the intrinsic properties of supernovas are considered. (J.F.P.)

7712 MAGNETIC STARS. Cowling, T. G. (Univ. of Leeds, England). pp. 425-63 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

In comparing theory with experiment, for the consideration of magnetic stars, a typical magnetic star is regarded as being of the type Ap. Observational data and the basic equations are presented. The virial theorem and stability, surface distortions due to a magnetic field, in which are included Ferraro's equilibrium solution and barocline stars, are treated. Force-free magnetic fields are considered, including general properties of force-free fields, magnetic braking, and theories of flares. Convection and turbulence and the origin of stellar magnetic fields, the latter topic including fossil magnetism and dynamo theories, are considered. Also magnetic variable stars are discussed. This includes the oblique-rotator theory, the magnetic oscillator theory, and the hydromagnetic-cycle theory. (J.F.P.)

7713 MERIDIAN CIRCULATION IN STARS. Mestel, L. (Cambridge Univ., England). pp. 465-97 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

The large-scale laminar circulation generated by non-spherical perturbations, the centrifugal and magnetic force, are considered. For radiative zones, a fairly well-developed theory exists, which may be applied to studies of stellar evolution, stellar motion, and probably to surface phenomena in hot stars. For convective zones there is the beginning of a phenomenological theory of laminar flow superimposed on the small-scale turbulence. This is considered the more promising field because of probable applications to the solar cycle. Topics considered are hydrostatic equilibrium of gaseous stars, thermal equilibrium (with both conservative and general perturbing forces), conditions for steady circulation, meridian circulation and stellar evolution, and conditions for steady mixing. Other theoretical consequences of meridian circulation in convective envelopes are also considered. (J.F.P.)

7714 STELLAR STABILITY. Ledoux, P. (Univ., Liege). pp. 499-574 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

A summary is given of the present state of knowledge concerning the stability of a star considered as a whole when it has reached a state of pure hydrostatic equilibrium or is very close to it. Some attention is paid to local instabilities such as may arise from superadiabatic gradients of temperature or differential rotation. Questions of gravitational instability related to the condensation of stars from interstellar material are omitted. The stability configurations in absolute equilibrium is treated, with the small perturbation method adopted. Topics discussed are the general equations and local stability, the general problem and its illustration for purely radial motion, dynamical stability, secular stability, and some comments on the effects of rotation, magnetic fields, or external gravitational fields. (J.F.P.)

7715 STELLAR EVOLUTION AND AGE DETERMINATIONS. Sears, R. L. (California Inst. of Tech., Pasadena); Brownlee, Robert R. pp. 575-641 of Stellar Structure. Lawrence H. Aller; Dean B. McLaughlin (eds.). Chicago, The University of Chicago Press, 1965.

Current descriptions of the physics of stellar evolution are summarized with particular attention to recent work. Details of construction of evolutionary sequences are considered by methods which have advantages for automatic high-speed computers. The application of the theory of stellar evolution to age determinations of stars is reviewed with attention to some of the major uncertainties which exist regarding this application at the present time. (J.F.P.)

7716 XENON AND KRYPTON FROM THE BRUDERHEIM METEORITE [Thesis]. Merrihue, Craig Morris. Berkeley, Calif., Univ. of California, 1965. 162p.

In a series of heating experiments, xenon, radiogenic $^{129}Xe_R$, and krypton contents and the xenon and krypton isotopic composition of the Bruderheim meteorite were studied for the separated minerals feldspar, pyroxene, olivine, and troilite and for numerous chondrule fractions. Importnat differences among the individual minerals and between minerals and chondrules were observed. The observed differences between chondrules and matrix material cannot be the result of processes acting after the meteorites formed. They reflect differences extant at the time of formation and argue for the presence of two or more types of primordial xenon. A high-temperature component is associated with chondrules, and a lower-temperature component with the matrix minerals. If this identification is correct, it provides strong support for the Suess-Wood hypothesis that chondrules represent a vapor-liquid precipitation from the primitive solar nebula and that matrix minerals represent a vapor-solid condensate. One hypothesis for differences between chondrules and matrix, consistent with the Suess-Wood hypothesis, is that all solids were equally irradiated during or after formation. During subsequent cooling, chondrules

were effectively isolated from the gas phase in the nebula by virtue of their larger size, whereas the fine-grained solids remained in equilibrium with the gases and ^{129}I down to a relatively low temperature. (A.G.W.)

7717 XIIIth INTERNATIONAL ASTRONAUTICAL CONGRESS, VARNA, 1962, PROCEEDINGS. [VOLUMES I AND II]. Boneff, N.; Hersey, I. Vienna; New York, Springer-Verlag, 1964. 1026p. $48.00. (CONF-620909(Pts.I and II)).

Issued in two volumes, cataloged as a unit.

The conference includes topics on lunar, solar, and planetary phenomena, atmospheric and space physics, bioastronautics, celestial mechanics, trajectory analysis and navigation, satellite attitude control, vehicle and propulsion technology, and communication satellites. (J.F.P.)

Atomic Physics

Refer also to abstract 6985.

7718 (KFK–329) DER EINFLUSS LONGITUDINALER MAGNETFELDER IM TARGET AUF DIE ZIRKULARPOLARISATION DER AUSSEREN BREMSSTRAHLUNG. (The Influence of Longitudinal Magnetic Fields in Targets on the Circular Polarization of External Bremsstrahlung). Schwarz, Herwig (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). May 1965. 36p. Dep. mn.

Bisi et al. reported that if targets were placed in magnetic fields, which were approximately parallel and antiparallel to the electron pulse, there was a change of the polarization degree of the external bremsstrahlung, dependent on the direction and intensity of the magnetic field in the target. These effects were investigated with an improved research installation on a ferromagnetic target in order to test whether the effects reported corresponded to an actual change of the polarization degree, whether they were caused by secondary effects as the polarization-dependent absorption of the external bremsstrahlung in magnetized iron, or whether an error occurred in the measurement. The circular polarization of the external bremsstrahlung was measured by Compton scattering on the partially polarized electrons of a cylindrical scattering magnet. The measurements, made in two energy regions (309 to 378 kev and 391 to 587 kev), showed that the circular polarization of the external bremsstrahlung was independent of the direction and intensity of the magnetic field at both energy regions. The effect of the polarization-dependent absorption of the external bremsstrahlung in the magnetic target on the circular polarization of the external bremsstrahlung was studied. In strong magnetic fields, the alteration of the circular polarization is 2.3×10^{-3}. (tr-auth)

7719 (NASA-TN-D–3134) CROSS SECTION FOR IMPACT IONIZATION OF H(1s) ATOMS BY H(1s) ATOMS NEAR THRESHOLD. Sheldon, John W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Dec. 1965. 14p. CFSTI $1.00 cy, $0.50 mn.

Rosen's treatment of impact ionization of neutral atoms is applied to the collision of ground-state hydrogen atoms near the ionization threshold. The singlet interaction potential is approximated by a Morse potential and the triplet interaction potential is approximated by an exponential repulsive potential. The energy-dependent ionization cross section is presented for collision energy between threshold and twice threshold. An implication of the classical path assumption is briefly discussed. (auth)

7720 (NASA-TN-D–3160) ATOMIC BEAM DETERMINATION OF THE CESIUM–CESIUM TOTAL SCATTERING CROSS SECTION. Sheldon, John W.; Manista, Eugene J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Dec. 1965. 32p. CFSTI $2.00 cy, $0.50 mn.

The cesium–cesium cross section is measured at three angular resolutions in the laboratory by total beam transmission through a scattering chamber containing cesium scattering atoms. The results show a marked dependence on laboratory angular resolution indicative of strong forward scattering. The forward scattering peak in the differential cross section is further evidenced by observations of broadening in the attenuated beam. The effective cross sections determined in the attenuations are correlated with an inverse r-sixth interaction and reduced to partial cross sections using the Berkling et al. tables. The partial cross sections are further analyzed within the framework of the semiclassical theory of Mason, Vanderslice, and Raw to obtain a method of extrapolation to zero angle in order to yield the total cross section corresponding to the assumed interaction $V(r) = -C/r^6$, where $V(r)$ is the interaction potential, C is the dispersion energy constant, and r is the interatomic distance. The total cross section determined by this method for cesium-cesium is 2500 $Å^2$ at a relative velocity of 2.3×10^4 centimeters per second. From the value of the cross section an interaction strength of $C = 4080 \times 10^{-60}$ erg-cm^6 is calculated from the Schiff, Landau-Lifschitz relation. The ratio of experimental to theoretical value of C is within the usual factor of 2 range found for other beam-gas interaction pairs. (auth)

7721 (RISO–115) CLASSICAL SCATTERING CROSS SECTIONS FOR RADIATION-DAMAGE CALCULATIONS. III. SECOND-ORDER APPROXIMATION OF THE BORN-MAYER POTENTIAL. Vajda, Peter (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). Sept. 1965. 21p. Dep. mn.

A method of matching interatomic potentials by a simple analytical form is extended, by including a quadratic term in the matching potential. Scattering angles are derived for different cut-off radii and incident-particle energies, and are compared with other approximations and the exact values obtained in machine calculations for the Born-Mayer potential. The agreement is best for small energy transfers, but good for large scattering angles. Differential cross sections for energy transfer are computed for copper-copper interactions in the relative energy range 0.6 to 8 kev and approximated by inverse-power cross sections. (auth)

7722 RECENT DEVELOPMENTS IN SPECTROSCOPY OF ATOMIC AND AUTOIONIZED BEAM CONTINUA. Kieffer, Jean; Damany-Astoin, Nicole (C.N.R.S., Bellevue, France). Ann. Astrophys., 28: 158-63(Jan.-Feb. 1965). (In French).

The principal research of the last ten years on atomic and autoionization continuation is reviewed. The elements discussed are restricted to the rare gases, alkali metals, and alkaline earths; and with one exception all of the work cited deals with absorption spectra. Experimental papers and the most important of the theoretical papers are included. The spectral region covered has only recently been studied, particularly wavelengths less than 1500 Å, because of the lack of availability of a source continuous in this region in order to study the structure of absorption spectra. Elements included in the review are (atomic absorption) Na, K, Rb, Cs, Mg, Ca, He, Ne, Ar; (autoionization) Ca, S, Ba, Cu, Au, Yb, He, Ne, Ar, Kr, Xe, N, and O. Forty-seven references are cited. (BBB)

7723 THE REPELLING INTERACTION POTENTIALS OF NOBLE GAS ATOMS. Kamnev, A. B.; Leonas, V. B. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 162: 798-800(June 1, 1965). (In Russian).

Repulsion effects can be determined by observing the elastic scattering at small angles. If it is assumed that the repulsion potential has the exponential form $V(r) = K/r^s$, classical scattering theory gives the following simple relation between the effective scattering cross-section at small angles and the potential parameters K and s: $S(\theta_0, E) = \pi(KC(s)/E\theta_0)^{2/s}$. Here $S(\theta_0, E)$ is the scattering cross-section at angles $>\theta_0$; E is the particle energy; C(s) is a numerical multiplier depending on s, and θ_0 is the minimum angle of deviation determined by the aperture. It is easy to find K and s from experi-

mental data of $S(\theta_0)$ as a function of E. Neutral particle beams with energies of 10^2 to 10^3 ev were produced in the ion source of a mass-spectrograph by passing the charged particles through a chamber where the charge was transferred by collision. Values of K and s respectively were found to be 2.8 and 3.9 for He–He, 78 and 7.65 for Ne–Ne, 171 and 6.06 for Ar–Ar, 22.6 and 5.15 for He–Ar, 10.3 and 5.61 for He–Ne, and 99.5 and 6.56 for Ne–Ar. These data are in good agreement with experimental and theoretical values presented in the literature. (TTT)

7724 FUNDAMENTAL STUDIES ON HEAVY ION REACTION. III. CHARGE CHANGING COLLISIONS OF C IONS. Genshikaki Kenkyu, 10: 303-13(July 1965). (In Japanese).

The equilibrium charge distributions of 9.7 Mev ^{12}C ions in formvar, C, Al_2O_3, Ag, and Au were measured. After traversing the foil the ions were separated according to charge by a 12,000 G magnetic field and recorded on a nuclear emulsion. Mean charges in these foils showed a systematic dependence on the atomic number of foil materials: formvar, 4.6; C, 4.7; Al_2O_3, 4.8; Al, 4.8; Ag, 4.7; and Au, 4.5. (auth)

7725 COMPARISON OF SECONDARY ELECTRON YIELD FROM FISSION FRAGMENTS EMERGING FROM AND IMPINGING UPON A THIN LAYER OF URANIUM DIOXIDE. Anno, J. N.; Jung, R. G. (Battelle Memorial Inst., Columbus, Ohio). J. Appl. Phys., 36: 3949(Dec. 1965).

The secondary electron yields from fission fragments emerging from and impinging upon a thin layer of uranium dioxide were measured. It was found that the yield for an emerging fragment was about twice that for an impinging fragment. (D.C.W.)

7726 K ELECTRON SHELL IONIZATION AND NUCLEAR REACTIONS. Ciocchetti, G.; Molinari, A. (Univ., Torino). Nuovo Cimento (10), 40B: 69-86(Nov. 11, 1965).

The K-shell ionization probability associated with α decay and nuclear reactions involving charged particles is calculated. The monopole and dipole term of the Coulomb interaction are considered as well as the nuclear recoil. Relativistic and screening effects are neglected. The theoretical predictions are in good agreement with experiment for α decay and 52-Mev α-particle x-ray production. A dependence of the ionization probability on the intermediate nuclear state lifetime is found. Coincidence experiments for determining nuclear time delays are discussed. (auth)

7727 IMPROVEMENTS IN THE MEASUREMENT OF ELECTRON DIFFUSION COEFFICIENTS BY THE LIGHT CHAMBER TECHNIQUE. Cavalleri, G.; Gatti, E.; Interlenghi, A. M. Nuovo Cimento (10), 40B: 450-3(Dec. 11, 1965).

Improvements in the measurement of thermal electron diffusion coefficients using the light chamber technique are reported. Measurements were carried out on neon, using x radiation to produce ionization and applying a clearing field pulse after every electron density sampling pulse. A value of $D_0 \simeq (2860 \pm 100)$ cm^2/sec was obtained and compared with previous results. (M.J.T.)

7728 ENERGY LOSS OF ELECTRONS IN THICK Cu FOILS. Van Camp, K. J.; Vanhuyse, V. J. (Rijksuniversiteit, Ghent). Phys. Lett., 19: 504-5(Dec. 1, 1965).

Energy loss distributions were measured for initial electron energies of 1.52, 2.65, and 3.66 Mev after penetration of several thick copper foils. Energy resolutions of the incoming electrons between 1.0 and 2.5% (f.w.h.m.) are obtained. The experimental results are listed. These results are compared with the theoretical widths, and the parameter, b^2, which accounts for resonance broadening, was computed. The results are discussed further. (J.F.P.)

7729 MEASUREMENTS ON CHARGE-CHANGING COLLISIONS INVOLVING NEGATIVE HYDROGEN, HELIUM, AND OXYGEN IONS. Jorgensen, T. Jr. (Univ. of Nebraska, Lincoln); Kuyatt, C. E.; Lang, W. W.; Lorents, D. C.; Sautter, C. A. Phys. Rev., 140: A1481-7(Nov. 29, 1965). (COO-35-77).

The determination of charge-changing collision cross sections for negative ions involves making measurements on other beam components as well. Beams of H^+, He^+, and O^+ were sent through a gas cell where charge exchange took place. Ratios of various charge components were obtained for thick targets. Negative-ion beams were sent through thin targets in a magnetic field and attenuation ratios were determined. Measurements were in the energy range from 10 to 400 kev. The observations on equilibrium ratios for hydrogen ions in various gases were in excellent agreement with previous work. Some new values of $\sigma_{0\bar{1}}$ and $\sigma_{\bar{1}0} + \sigma_{\bar{1}1}$ for a hydrogen-gas target are presented. ($\sigma_{0\bar{1}}$ = cross section for a change from charge 0 to −1, etc.) The observations on the helium beam were limited to the beam-fraction ratio $F_{\bar{1}}/F_1$. This ratio did not approach an equilibrium value, except in the case of the helium target, but rather reached a maximum and continued to decrease for thicker targets. The maximum values of $F_{\bar{1}}/F_1$ are presented for gas targets of hydrogen, helium, nitrogen, oxygen, and argon. The values of $\sigma_{\bar{1}0} + \sigma_{\bar{1}1}$ are given for a hydrogen target and values of $\sigma_{0\bar{1}}$ determined with the aid of previously published data are presented. The observations on the oxygen beam allowed the determinations of beam fractions $F_{\bar{1}\infty}$, $F_{0\infty}$, $F_{1\infty}$, $F_{2\infty}$, $F_{3\infty}$ for hydrogen, helium, and oxygen targets. Using these quantities it was possible to determine certain individual charge-changing cross sections after making simplifying assumptions concerning the negligible magnitude of some of the cross sections. These cross sections and the beam fractions are presented for the three gases. (auth)

7730 OPTICAL EXCITATION WITH VERY LOW ENERGY IONS. Lipeles, M.; Novick, R.; Tolk, N. (Columbia Univ., New York). Phys. Rev. Lett, 15: 815-19 (Nov. 22, 1965).

Radiation due to the impact of very slow helium ions was observed on the rare gases and on some molecular gases. The dependence of the cross section for this process on the kinetic energy of the He^+ beam shows unexpected features down to the lowest energies studied (5 ev). For example, there is a sharp peak at 10 ev for the production of uv photons in Xe. The absolute cross sections are typically of the order of 10^{-16} cm^2 and in some cases are almost an order of magnitude larger. In at least one case the radiation was shown to result from charge exchange with similar excitation. Energy balance considerations show that the reactions studied involve the transfer of a large fraction of the kinetic energy into internal electronic energy. The excitation clearly involves nonadiabatic nonradiative transitions between the levels of the molecular-ion complex formed during the collision. The low-energy peaks in the cross section imply that the molecular energy levels are shifted in energy during the collision until they nearly cross. The experimental apparatus and data obtained are discussed. Curves are given showing the kinetic-energy dependence of the cross sections for the production of photons by He^+ impact on the rare gases. (J.F.P.)

7731 ELECTRON CAPTURE FROM ATOMIC HYDROGEN. Grant, J.; Shapiro, J. (Fordham Univ., New York City). Proc. Phys. Soc., 86: 1007-16(Nov. 1965).

The differential and total cross sections for the resonance charge transfer reaction $H^+ + H(1s) \rightarrow H(1s) + H^+$ are calculated in a distorted wave approximation retaining terms of third order in the interaction potentials. It is found that, for energies above 10 kev, the only significant third-order term arises from the incident proton–electron interaction, the proton–proton term being smaller by a factor equal to the electron–proton mass ratio. In the infinite energy limit the third-order contributions vanish as $E^{-\frac{1}{2}}$ relative to the first Born terms, while at moderate energies (10 kev to 500 kev) they result in an increase of about 40% in the calculated cross sections. The probability of capture into excited

states of the hydrogen atom is investigated. The analysis yields a correction factor which, combined with the cross sections for 1s−1s transitions, yields an estimate of the cross sections for capture into all final states. These results are compared with the existing experimental data, and a generally good agreement is obtained. (auth)

7732 ATOMIC μ^--MESON CAPTURE IN CHEMICAL COMPOUNDS. Zinov, V. G.; Konin, A. D.; Mukhin, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 2: 859-67(Nov. 1965). (In Russian).

The atomic capture of mesons (μ^-) in binary compounds was investigated. The ratio of the probabilities of atomic capture in the oxides changes with the increase of the atomic number in accordance with the periods in Mendeleev's table. This ratio depends on the type of the compound (e.g., MgO and MgO_2, etc.). The probability ratio of capture in the metal-halogen compounds and in alloys is shown to be described satisfactorily by the linear dependence 0.66 (Z_1/Z_2). (auth)

7733 ELECTRON POLARIZATION IN THE ENERGY REGION BELOW 50 ev BY SCATTERING ON FREE Hg ATOMS. Deichsel, H.; Reichert, E.; Steidl, H. (Univ., Mainz). Z. Phys., 189: 212-16(1966). (In German).

The angular dependence of spin polarization $P(\Theta)$ of electrons elastically scattered by a beam of mercury atoms is measured in a double scattering experiment for electron energies of 45 ± 1, 23 ± 1, 7 ± 1, and 3.5 ± 1 ev. Maximum degree of polarization obtained is $P(100°) = 0.39 \pm 0.07$; electron energy 7 ± 1 ev; electron current $10^{-12} - 10^{-11}$ amp. (auth)

7734 RATE OF TRANSFER OF MUONS FROM pμ ATOMS TO THE NUCLEI OF OTHER ELEMENTS. Basiladze, S. G.; Ermolov, P. F.; Oganesyan, K. O. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 49: 1042-8(Oct. 1965). (In Russian).

The rate of transfer on a negative muon from a pμ atom to the nuclei of carbon, argon, and xenon is measured with a gas target arrangement filled with hydrogen up to 45 atm. The transfer rates obtained (referred to the density of normal liquid hydrogen) are $\lambda_C = (5.1 \pm 1.0) \times 10^{10}$ sec^{-1}, $\lambda_A = (12.0 \pm 1.9) \times 10^{10}$ sec^{-1} and $\lambda_{Xe} = (44.6 \pm 3.6) \times 10^{10}$ sec^{-1} can be satisfactorily approximated by the dependence $\lambda_Z \sim Z$. (auth)

7735 DETACHMENT OF ELECTRONS FROM H^- IONS IN COLLISIONS WITH INERT GAS ATOMS. Bydin, Yu. F. Zh. Eksp. Teor. Fiz., 49: 1094-6(Oct. 1965). (In Russian).

The effective cross sections Q_d for detachment of electrons from negative H^- ions in single collisions with He, Ne, Ar, Kr, and Xe atoms are measured in the ion energy range between 200 and 7000 ev. The results are compared with the theory of interaction between negative ions and atoms proposed by Smirnov and Firsov. (auth)

7736 BREMSSTRAHLUNG IN A STRONG RADIATION FIELD. Bunkin, F. V.; Fedorov, M. V. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 49: 1215-21(Oct. 1965). (In Russian).

A method is developed for determining the cross sections for multiquantum bremsstrahlung and absorption in the presence of a strong electromagnetic field. Bremsstrahlung due to the scattering on a Coulomb potential is considered in detail. In the extreme case of small fields the results obtained are identical with the familiar perturbation theory formulas. Asymptotic expressions are found for the bremsstrahlung cross sections in strong fields. (auth)

7737 ON BREMSSTRAHLUNG RADIATION. Pafomov, V. E. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 49: 1222-7(Oct. 1965). (In Russian).

The angular distribution and degree of polarization of bremsstrahlung radiation are calculated for a relativistic charged particle traversing a layer of matter whose thickness is less than the radiation length. Emission of quanta with frequencies much greater than the optical and energies much smaller than that of the particle is considered. (auth)

7738 THE RADIATIVE CORRECTIONS TO THE HYPERFINE STRUCTURE IN HYDROGEN [Thesis]. Brodsky, Stanley Jerome. Minneapolis, Univ. of Minnesota, 1964. 104p.

A new calculation of the one-photon self-energy correction to the hyperfine splitting in hydrogen is presented. The work is based upon a new gauge-invariant reduction of the formal level shift formula given by G. E. Erickson and D. R. Yennie. Operator techniques are emphasized in the calculation; in particular, a formal operator expression is used for the magnetic dipole perturbation to the relativistic Coulomb wave function. Contributions to order $\alpha(Z\alpha)^2$ are located for the purpose of future calculation. A review of the physical contributions to the hyperfine splitting is included. The logarithmic radiative corrections are found to increase the previously noted discrepancy with experiment by 9 parts per million. The difference between the predicted and measured values for the ground state splitting becomes −43 ± 20 parts per million, where the error limits are essentially due to the uncertainty in the experimental value of the fine structure constant. (A.G.W.)

7739 LINEAR POLARIZATION OF X RADIATION FROM A MERCURY VAPOR TARGET [Thesis]. Huffman, Fred Norman. Baltimore, Johns Hopkins Univ., 1964. 140p.

The linear polarization of x rays produced by electron bombardment of a mercury vapor target is analyzed by measuring the scattered intensity from beryllium parallel and perpendicular to the emission plane specified by the directions of the photon and incident electron. Energy resolution is accomplished by a xenon-methane filled proportional counter used in conjunction with a multichannel analyzer. The results give the polarization as a function of incident electron energy, photon energy, and photon emission angle. These values may be more properly compared with theory than previous measurements, because the vapor target approaches an ideally thin target. Comparison of these measurements with the Kulenkampff, Scheer, and Zeitler relativistic transformation of the Sommerfeld theory of the continuous x-ray spectrum indicates substantial agreement with theory. However, at high bombardment potentials the experimental polarization is significantly lower than theory predicts. The design features of the polarimeter and the circulating mercury vapor target tube are described. The Fortran II program associated with the study is listed. (Dissertation Abstr.)

7740 SPECTRA INDUCED BY PROTON IMPACT ON HELIUM [Thesis]. Dodd, Jack Gordon Jr. Little Rock, Ark., Univ. of Arkansas, 1965. 54p.

Spectra induced by proton impact on helium in the energy range of 20 to 130 kev are reported. From these spectra absolute cross sections were determined for production of the helium transitions 2^1P-n^1S (n−3,4,5), 2^1S-3^1P, and HeII (3−4). Cross sections were also estimated for excitation into the 3^1P, 3^1S, 4^1S and 5^1S states, for simultaneous ionization (including charge transfer) and excitation of helium into the n = 4 state of He^+, and for production of H in the n = 3 and n = 4 states by charge transfer. (Dissertation Abstr.)

7741 SPECTROSCOPIC STUDY OF CONTROLLED PROTON IMPACT ON MOLECULAR NITROGEN [Thesis]. Philpot, John Lee. Little Rock, Ark., Univ. of Arkansas, 1965. 78p.

Protons of energy 5-130 kev were passed into molecular nitrogen gas at low pressure and the resulting radiation was spectroscopically analyzed. Prominent emissions studied were: (1) two N_{II} lines located at λ5005Å and λ5680Å; (2) bands of the N_2^+ first negative band system ($B^2\Sigma - X^2\Sigma$); and (3) two Balmer lines, H_α and H_β, formed by charge-changing collisions with nitrogen molecules. Absolute cross sections for the production of these emissions were measured as a function of the energy of the incident protons. Population cross sections for the $v^1 = 0$ and $v^1 = 1$ levels of the $B^2\Sigma$ state of N_2^+ were obtained as well as an estimate of the level

population cross section of the n = 3 and n = 4 levels of atomic hydrogen formed by charge exchange. (Dissertation Abstr.)

7742 BOUND STATE TECHNIQUES FOR THE INVESTIGATION OF RESONANCES IN ELECTRON SCATTERING FROM ATOMIC HYDROGEN [Thesis]. Walker, James Frederick Jr. Minneapolis, Univ. of Minnesota, 1964. 91p.

Recent theoretical investigations into the problem of electron scattering from atomic hydrogen have revealed resonances in the elastic cross section at energies just below the inelastic threshold. Since these resonances have not been found experimentally, various techniques for investigating them more directly are under consideration. It is shown that a very strong analogy exists between the resonances and the bound state of the two electron-single proton system (H^- ion) if the H^- problem is considered from the point of view of expansions in terms of hydrogenic wave functions. On the assumption that the analogy can be made, it is proposed that techniques that give the proper binding of the H^- will be applicable to finding the positions of resonances. The techniques investigated were restricted to expansions in hydrogenic functions. It is shown that taking only the discrete states of the hydrogen spectrum into account in the expansion apparently gives only about sixty percent of the H^- binding energy. A procedure for estimating the effect of the continuum is proposed. (Dissertation Abstr.)

7743 LABORATORY WORK IN MODERN PHYSICS. Radioactivity and Charged Particles. Avery, J. H.; Ingram, A. W. K. London, Heinemann Educational Books Limited, 1965. 125p. 13s 6d.

The more important experiments which can be performed in a laboratory are described in detail. A brief theoretical treatment is given for each. The topics covered include standard procedure, analog experiments and statistics of counting, characteristics of instruments, absorption experiments, the half-life and decay constant of radon-220, the range of alpha particles in air, properties of beta and gamma radiation, and electron experiments. (J.F.P.)

7744 NUCLEAR MAGNETIC RESONANCE IN LIQUID METALS [Thesis]. Berger, August Gehard Jr. Berkeley, Calif., Univ. of California, 1965. 83p.

Data necessary for the analysis of nuclear magnetic resonances in liquid metals are here collected, discussed, and applied to development of a consistent treatment for eleven metals: Li, Na, Rb, Cs, Al, Ga, Cd, In, Sn, Hg, and Bi. The Knight shift (K) and the electron spin susceptibility (χ_p) are used to evaluate the metallic contact interaction parameter (P_F). Taken with the atomic hyperfine coupling constant (a), these data are also used to evaluate the ratio of P_F to the corresponding atomic interaction parameter (P_A). It is shown that the free-electron (FE) and nearly free electron (NFE) models, which successfully represent some metallic properties, are not adequate for χ_p. The nearly free interacting electron (NFIE) model gives reasonable values for electron effective masses and spin susceptibilities. The agreement with spin-resonance values for χ_p in Li and Na metals is better than in previous analyses. Effective-mass ratios derived from low-temperature specific-heat measurements and theoretical calculations compare favorably with ratios obtained by the method presented. It is found that s character, as measured by P_F, remains essentially unchanged or decreases significantly in the liquid-solid transition. Specifically, P_F changes by less than about 5% for ^{7}Li, ^{23}Na, ^{87}Rb, ^{133}Cs, and ^{115}In, and decreases by 10% to 30% for ^{27}Al, ^{111}Cd, ^{119}Sn, and ^{199}Hg nuclear resonances when these metals crystallize. It is concluded that a satisfactory interpretation of liquid-metal nuclear-resonance characteristics can be made if the NFE model for χ_p is adjusted to include electron-electron interactions in an NFIE model. Structural changes produce changes in wave-function s character. A spherical Fermi surface with effective-mass modification is indicated for liquids, but some local anisotropy in wave functions is allowed. (Dissertation Abstr.)

7745 POPULATION OF EXCITED STATES IN FAST HELIUM ATOMS BY ELECTRON CAPTURE FROM HELIUM, NITROGEN, AND OXYGEN GASES BOMBARDED BY SINGLY IONIZED HELIUM [Thesis]. Head, Charles Everett. Little Rock, Ark., Univ. of Arkansas, 1965. 102p.

Collision cross sections were measured for electron capture into the 3^1D, 3^3D, 4^1D, and 4^3D states of fast helium atoms for He^+ impact on N_2, for electron capture into the 3^3S, 3^1P, 3^3P, 3^1D, 3^3D, 4^3S, 4^1S, 4^1D, 4^3D, and 5^1D states of He for He^+ impact on He, and for electron capture into the 3^3D state of He for He^+ impact on O_2. The kinetic energies of the He^+ were varied from about 20 to about 120 kev for all measurements except for capture into the 4^1S and 4^3S states for impact on He. (Dissertation Abstr.)

7746 RELATIVISTIC CORRECTIONS FOR THE FINE STRUCTURE OF HELIUM [Thesis]. Kim, Kee Yong. Berkeley, Calif., Univ. of California, 1965. 64p.

Relativistic corrections to the fine structure of the hydrogen atom have been calculated by many authors, but the experimental confirmation of the theory, and alternatively the determination of the numerical value of the fine-structure constant α is limited to an accuracy of $1/10^5$ because of the short lifetime of 2^2P states of hydrogen. However, in view of the fact that 2^3P states of helium have a longer lifetime, it is expected that the fine-structure intervals of the 2^3P states of helium can be measured to an accuracy of $1/10^6$ or better. With this expectation, an attempt was made to evaluate semi-relativistically the theoretical formula for the helium fine structure up to the order of α^4 Ry. (Dissertation Abstr.)

Cosmic Radiation

See also Elementary Particles and Radiations
Nuclear Properties and Reactions

Refer also to abstracts 7367, 7383, and 8218.

7747 (NP–15591) DISTRIBUTION OF SPALLATION PRODUCED CHROMIUM BETWEEN ALLOYS IN IRON METEORITES. Shima, Masako; Honda, Masatake (Tokyo Univ. (Japan). Inst. for Solid State Physics). Sept. 1965. 32p. Dep. mn.

Chromium nuclides produced by cosmic rays were measured mass-spectrometrically in iron meteorites. A surface ionization method was applied, with chromium finally isolated from the samples by a solvent extraction method. A marked enrichment of ^{54}Cr and ^{53}Cr could be observed. Sulfuric acid dissolved a bulk of meteorite selectively, leaving a small residue of a nickel-rich metal phase, which contained relatively high concentrations of natural chromium. An isotopic dilution analysis using enriched ^{50}Cr or ^{52}Cr was made to obtain absolute contents of those nuclides. In the cases of Grant and other meteorites, the nickel-rich (taenite-rich) fraction was found to contain a higher concentrations of these products than the nickel-poor (kamacite-rich) fraction, which was readily soluble in acid. The overall contents of ^{54}Cr were found to be in the range of 13 to 25 ppb in several meteorites, and the ratios ^{50}Cr : ^{53}Cr : ^{54}Cr were found always to be approximately 0.2 : 1 : 1 respectively. The enrichment of these chromium nuclides in taenite was confirmed by several methods. The interpretation of this phenomenon was discussed from a cosmochemical viewpoint. (auth)

7748 (NASA-TT-F-91) VARIATIONS OF COSMIC RAYS AND SOLAR CORPUSCULAR STREAMS: COLLECTION OF ARTICLES. Vernov, S. N.; Dorman, L. I. (eds.) Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960). 183p. CFSTI $5.00 cy, $1.00 mn.

Ten articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 7749–7758.

7749 (NASA-TT-F-91, pp 1-63) INDIVIDUAL CASES OF THE INFLUENCE OF MAGNETIC STORMS ON COSMIC RAYS AND THEIR INTERPRETATION. Blokh, Ya. L.; Dorman, L. I.; Kaminer, N. S. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

An analysis of several cases of the decrease in the intensity of cosmic rays during magnetic storms of different types (about 40 storms) is given. For every case the profile is determined of the intensity variations (I, II, and III types), the characteristics of which are connected with the properties of the magnetic storm (with sudden or gradual commencement), with the character of capture of the Earth in the corpuscular stream (by forward front or side edge), with the velocity of the steam and its geometric parameters, and with the distribution and tension of the magnetic field frozen in the stream. The properties of streams appear to be largely different. However, general regularities are observed inherent to most of the streams. Data are also given on the effect of the increase before the commencement of the magnetic storms under discussion. (P.C.H.)

7750 (NASA-TT-F-91, pp 64-81) VARIATIONS OF COSMIC RAY INTENSITY DURING THE PERIOD WHEN THE EARTH IS CAPTURED BY CORPUSCULAR STREAMS CARRYING HOMOGENEOUS AND INHOMOGENEOUS FROZEN MAGNETIC FIELDS. Dorman, L. I. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

Results of calculations of the expected profile of the intensity variations of the neutron and meson components of cosmic rays are presented. The calculations are given for different cases of the Earth's capture in the stream with homogeneous frozen magnetic field with 300 $H_{\delta}01_{\delta}$ = 40, 60, 80, 100, and 120 Bev for the velocities of the front 10^7, 2×1^7, 3.5×10^7, 6×10^7, 1.2×10^7, and 2.4×10^8 cm/sec. The profile was determined for the variations of the boundary energy of the variations spectrum 8_{min} with the following distribution of the field in the stream: lineary fall from H_{max} at the leading edge of the stream to H_{min} at the lagging edge (with the change of H_{min}/H_{max} from 0 to 1); the fall along the parabola from H_{max} to H_{min}; the profile of the field in a triangular form with the maximum at different distances from the leading edge of the stream; the profile of the field with the minimum in the middle of the stream. The profile was also calculated from the 8_{min} changes with different suppositions about the character of field compression in the frontal part of the stream for different cases of the Earth's capture in a stream and for different values of the stream's velocity. (auth)

7751 (NASA-TT-F-91, pp 82-106) DIURNAL VARIATIONS OF THE HARD COMPONENT OF COSMIC RAYS NEAR THE MINIMUM OF SOLAR ACTIVITY. Glokova, E. S. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

It is shown that the mean yearly diurnal wave in the hard component of the cosmic rays could be expressed by the sum of two vectors. One of these vectors changes with the cycle of the solar activity, the other, being constant, does not depend on solar activity. When the minimum of solar activity approaches, the amplitude of the variable vector decreases, and this is the main cause of the changes of the observed diurnal wave near the minimum. Data have been received proving the fact that the variable component is created by the anisotropy of cosmic rays outside the limits of the geomagnetic field, and the constant component is mainly of temperature origin. The seasonal changes of the diurnal variation are discussed. It is shown that the seasonal changes in the Northern and Southern latitudes are to a great extent connected with the temperature effect. However, there are other causes which produce the seasonal changes of the diurnal wave on the equator and the additional seasonal variation in the years of high solar activity. Experimental data on the hard component do not provide reasons to suppose that in 1954 a special stellar-diurnal variation appeared, which was absent from that component during other years. (auth)

7752 (NASA-TT-F-91, pp 107-15) DETERMINATION OF THE ENERGY SPECTRUM OF THE PRIMARY DIURNAL VARIATIONS OF THE COSMIC RAY INTENSITY. Krupitskaya, T. M. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

The energy spectrum of the diurnal variations was determined according to the observations materials of the neutron and meson components obtained at a number of stations of the World network for the period of July 1957 – June 1958. The relation of amplitudes of the neutron and meson components was applied in the determination of the parameters of the spectrum. It was found that the lower limit of the variations spectrum is (7.1 ± 0.9) Bev. (auth)

7753 (NASA-TT-F-91, pp 116-20) CHANGES IN THE AMPLITUDE OF THE DIURNAL VARIATION OF COSMIC RAY INTENSITY AS A FUNCTION OF THE MAGNETIC ACTIVITY. Zhukovskaya, N. A.; Ol', A. I. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

Data obtained at 12 stations in the middle and high latitudes for 1957–1958 with corrections for barometric effect were used. The amplitude of the diurnal variation was determined by harmonic analysis (1 harmonic). The amplitudes thus received were averaged for several days with different rate of magnetic activity grouped together. The results obtained showed that on the background of continuous increase of the amplitude of diurnal variation with the increase of magnetic activity systematic decrease of amplitude is observed for the group of days with ΣKp = 24-33. Probable causes of the revealed effect are discussed. (auth)

7754 (NASA-TT-F-91, pp 121-6) ANISOTROPY OF COSMIC RAYS CAUSED BY THE ELECTRIC FIELD OF A CORPUSCULAR STREAM. Dorman, L. I. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

Results are given of energy variations under the influence of the electric field and the impulse intervals where the particles acquire or lose energy (with consideration of the influence of the magnetic field in the streams on the trajectories of the particles). Calculations are made for different positions of the Earth in the stream and for different trajectories of the particles (closed and open). The energy spectrum of the anisotropy which results from the influence of the electric field of corpuscular streams with regular homogeneous and inhomogeneous frozen magnetic field is given. (auth)

7755 (NASA-TT-F-91, pp 127-50) DIURNAL VARIATIONS OF COSMIC RAYS CAUSED BY ANISOTROPIC SCATTERING OF PARTICLES BY INHOMOGENEOUS MAGNETIC FIELDS OF CORPUSCULAR STREAMS. Dorman, L. I. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

Diurnal variations of cosmic rays which result from the anisotropic scattering of particles by the frozen regular homogeneous and inhomogeneous magnetic fields are discussed. The problem was solved in the general aspect for the field lying perpendicular to the line of the distribution of the stream. The energy spectrum of the variations was found as the function of the local time for different distributions of the magnetic field in the stream without consideration and with approximate consideration of further influence of the magnetic field on the trajectories of the particles. With the appliance of the coupling coefficients the expected variations of the intensity of the neutron and meson components of cosmic rays were determined on the sea level and on the mountain level at stations with different geomagnetic threshold for different distributions of the frozen field and for different positions of the Earth in the

stream. Approximate values of the changes of results in calculation of the diagram of the instruments' direction are given. (auth)

7756 (NASA-TT-F-91, pp 151-7) VARIATION OF COSMIC RAY INTENSITY DURING MAGNETIC STORMS WITH SUDDEN AND GRADUAL BEGINNINGS. Ol', A. I. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

According to the observation materials of the meson and neutron components of cosmic radiation obtained at the Heiss I. high latitude observatory and at some middle latitude stations it has been found that in 1957–1958 the magnetic storms with gradual commencement were followed by the increase in the intensity of cosmic rays, while the storms with sudden commencement—by the decrease. In 1937–1946 the storms with gradual commencement were not connected with any significant variations in the intensity of cosmic rays, and large storms with sudden commencement were followed by the decrease. A supposition is offered that the increase in the intensity observed during the magnetic storms with gradual commencement could be characteristic only of this cycle of solar activity due to its extraordinary high level. (auth)

7757 (NASA-TT-F-91, pp 158-63) RELATIONSHIP OF THE COSMIC RAY INTENSITY TO SOLAR ACTIVITY. Fedchenko, K. K. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

Data on the variations of the hard and neutron components obtained at Boukhta Tixie, Heiss I., and in Moscow for the 1954–1958 period with corrections for the barometric effect are used. It is shown that the effect of cosmic rays connected with the solar activity during the maximum (decrease of intensity) is to a greater extent determined by spots than flocculae; during the minimum this effect is small in both cases. Some groups of spots of the largest type, occurring only in the years of high solar activity, while passing across the central zone of the Sun can bring about everywhere (except the equatorial latitudes) considerable increase of the intensity of cosmic rays in the neutron (~4%) and the hard (~2%) components. Possible causes of the increase are discussed. (auth)

7758 (NASA-TT-F-91, pp 164-8) RELATIONSHIP OF THE COSMIC RAY INTENSITY TO THE MAGNETIC ACTIVITY AND RADIO EMISSION OF THE SUN. Ol', A. I.; Tyasto, M. I. Translated from Mezhduved. Kom. Provediniyu MGG. Sb. Statei VII Rozdel Programmy MGG, No. 2 (1960).

Results of a study on the relation between radio emission of the Sun, intensity of cosmic rays and magnetic activity according to the registration materials of the solar radio emission at a number of Soviet and foreign stations, and the registration of the meson and neutron components of cosmic rays are presented. The study was carried out with the application of the method of epoch overlapping for 1951–1952, 1953–1955, and 1958 periods. It is shown that the increase of radio emission, connected with the decrease of the intensity of cosmic rays, brings about the increase of magnetic activity, while the increase of radio emission, connected with the increase of the intensity of cosmic rays, are followed by the decrease of magnetic activity. The conclusions are compared with the results obtained by others. (auth)

7759 SOLAR EFFECTS ON THE COSMIC RADIATION AT THE VOSTOK STATION—SEPTEMBER 1963. Fischer, S. (Inst. of Physics, Slovak Academy of Sciences, Lomnicky Stit); Krivsky, L. Bull. Astron. Inst. Czech., 16: 316-19(1965).

Processing was performed for the measurement of cosmic radiation by a neutron monitor at hourly intervals from the Vostok station in the Antarctic from the period of September 12, 1963 till October 9, 1963, when the solar activity was extraordinarily enhanced. Important flares connected with ejections of clouds of particles with a magnetic field that produced Forbush effects were determined. (auth)

7760 AN INVESTIGATION OF THE CHARGED PARTICLE FLUXES WITH AN ENERGY OF 1 KEV ON THE SATELLITE COSMOS-15. Savenko, I. A.; Savin, B. I.; Melnikov, V. V.; Shavrin, P. O.; Markelova, T. N. (Moscow State Univ.). Geomagn. Aeronomiya, 5: 749-51(July-Aug. 1965). (In Russian).

An electrostatic analyzer was adapted for the Cosmos-15, providing it with a charged screen at the inlet to prevent positive thermal ions from reaching the instrument. If the radiation is assumed to be isotropic, the sensitivity of the system was 20 Mv, corresponding to about 1.2×10^7 particles/cm^2 sec kev. The Cosmos-15 was launched on April 22, 1963, achieving an orbit with an apogee of 371 km, a perigee of 173 km, and an inclination of 65°. During the night portions of the orbits the analyzer did not record electron or ion fluxes with an energy of 1 kev and with intensities exceeding about 10^7 particles/cm^2 sec kev; it did record electrons of higher energy. During the day the signals received from the analyzer indicated two bands of maxima situated at the same latitude and shifting gradually toward the north. The daytime recordings were attributed to photoelectron fluxes. The location of the two maxima checks with the incidence of daylight in the gap between the measuring spheres. (TTT)

7761 NATURE AND ENERGY SPECTRA OF THE SOLAR DIURNAL AND SEMIDIURNAL VARIATIONS DURING SOME FORBUSH EFFECTS. Dorman, L. I.; Kolomeetz, E. V.; Pivneva, V. T.; Sergeeva, G. A. (Kazakh State Univ., USSR). Geomagn. Aeronomiya, 5: 760-2 (July-Aug. 1965). (In Russian).

Solar diurnal and semidiurnal variations were examined during the periods of November 1 to 2, 1958, April 11 to 13, 1960, April 29 to 30, and May 1, 1962, on the basis of the neutron component of the cosmic radiation, corrected for the barometric effect. In the harmonic analysis, corrections were made for the Forbush effect. A daily variation was found in the intensity of the cosmic radiation and in the H component of the terrestrial magnetic field. The cosmic radiation data could be correlated inversely with the variations of the H component in two cases and directly in one case. The amplitude of the semidiurnal variations correlated well with the diurnal ones up to energies of 13 Bev. The energy spectra were obtained by using the correlation coefficients. It was found that the amplitude of the diurnal variations was largest in the western hemisphere, decreasing gradually toward the east; this indicates that the effect of a local source predominates during magnetic storms. No clear correlations were found for the semidiurnal variations. With increasing energy, the time of the daily maximum variations shifted toward the early hours. (TTT)

7762 ANISOTROPY OF COSMIC RAYS IN THE GALACTIC ARM. Sakakibara, Shizuko (Nagoya Univ., Japan). J. Geomagnet. Geoelec., 17: 99-112(1965).

On the assumption that a magnetic field of the order of the 10^{-5} gauss lies along a spiral arm of the Galaxy pointing to the outward-directed spiral arm and our solar system locates near the boundary of the arm, the anisotropy is explained by considering diffusion of cosmic rays in the arm. That is, the time of maximum sidereal variations in the lower energy region, 20 hour, corresponds to one of the direction of flow along the field lines, while the time of maximum in the higher energy region, 12 hour, and also the energy dependence of the amplitude are expected as the results of the diffusion of cosmic rays due to the density gradient from the axis to the boundary of the arm. (L.B.S.)

7763 THE NOTTINGHAM COSMIC-RAY SPECTROMETER. I. Bull, R. M.; Nash, W. F.; Rastin, B. C. (Univ. of Nottingham, Eng.). Nuovo Cimento (10), 40A: 348-64(Nov. 21, 1965).

Measurements of the sea-level μ-meson momentum spectrum made during the last decade utilizing conven-

tional air gap spectrometers indicated that the differential intensity is approximately proportional to 1/(momentum)^3 For a study of the high-momentum region therefore, the instrument concerned must not only have a high angular resolution but also be able to accumulate data at a significant rate. These requirements can be met only with difficulty when conventional air gap magnets are used. The characteristics of a μ-meson spectrometer in which the air gap magnet is replaced by a block of magnetized iron are considered. Methods are given for computing the effects of energy loss and scattering in the material, and it is shown that the angular scattering distribution produced by the iron in the unmagnetized state can be accurately predicted. Since the magnetic material acts as a filter for nuclear active particles, this type of instrument has all the advantages of operating underground while retaining the convenience of working at sea level. (auth)

7764 THE MOMENTUM SPECTRUM AND CHARGE RATIO OF μ-MESONS AT SEA-LEVEL. II. Bull, R. M.; Nash, W. F.; Rastin, B. C. (Univ. of Nottingham, Eng.). Nuovo Cimento (10), 40A: 365-84(Nov. 21, 1965).

The sea-level momentum spectrum of single cosmic-ray μ mesons was measured for near vertical incidence within the range 2.34 Bev/c < p < 360 Bev/c. A comparison is made between the measured spectrum and that predicted on the basis of a model involving the diffusion of particles through the earth's atmosphere, enabling a value to be ascribed to the exponent of the primary spectrum. The variation of the charge ratio with energy obtained from the experiment is compared with the results of other workers as well as the more recent theoretical predictions. Tentative evidence is provided for an increase in the charge ratio above 40 Bev, although at present the experimental data in this region prohibit drawing definite conclusions concerning the exact mechanism of the primary interactions. (auth)

7765 A STUDY OF THE PRODUCTION OF γ-RAYS IN HIGH-ENERGY NUCLEAR INTERACTIONS. I. THE ENERGY SPECTRA OF NUCLEAR AND γ-RAY CASCADES OBSERVED AT BALLOON ALTITUDES. Malhotra, P. K.; Shukla, P. G.; Stephens, S. A.; (and others) (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 40A: 385-403(Nov. 21, 1965).

A composite detector of heavy metal and nuclear emulsion was used to investigate electromagnetic cascades produced by cosmic radiation. The stack was exposed on a balloon near the top of the atmosphere for 28 hr. Approximately 4000 cascades were observed, and these were classified as arising from nuclear interactions in the overlying atmosphere, in the detector itself, or in a thin graphite layer surrounding the detector. The energies of the cascades were estimated from their electron track density. The energy spectra of the various types of cascades are presented, and these are compared with similar measurements made at greater depths in the atmosphere. (auth)

7766 A STUDY OF THE PRODUCTION OF γ-RAYS IN HIGH-ENERGY NUCLEAR INTERACTIONS. II. A STUDY OF INDIVIDUAL HIGH-ENERGY INTERACTIONS IN GRAPHITE. Malhotra, P. K.; Shukla, P. G.; Stephens, S. A.; (and others) (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 40A: 404-23(Nov. 21, 1965).

An analysis is given of 46 nuclear interactions occurring in graphite in each of which at least 1300 Bev were radiated as γ rays. In each event the energies and relative angles of all γ rays within certain fiducial limits were measured. Data are presented concerning the multiplicity of γ rays and their energy and transverse-momentum distributions. (auth)

7767 DAY-TO-DAY CHANGES IN THE ENERGY SPECTRUM OF THE DAILY VARIATION OF COSMIC-RAY INTENSITY. Kane, R. P. (Physical Research Lab., Ahmedabad, India). Nuovo Cimento (10), 40A: 476-85(Nov. 21, 1965).

Day-to-day changes in the ratios of amplitudes and differences between the hours of maxima of the first harmonics of the daily variations of the nucleonic component at middle latitudes and at the equator are studied for the I.G.Y. period. It is concluded that apart from the unique sources of daily variation outside geomagnetic influence and local sources within the geomagnetic field, other sources effective predominantly at middle latitudes only or at equatorial stations only seem to exist for the first harmonic. The average second harmonic seems to be a predominantly equatorial phenomenon due to either a local source or alternatively a source in directions about 120°W or 60°E of the earth-sun line and most probably unconnected with the first harmonic. (auth)

7768 AN UPPER LIMIT TO THE EXISTENCE OF CHARGES (2/3)e IN THE COSMIC RADIATION AT 500 m ABOVE SEA LEVEL. Massam, T.; Muller, Th.; Zichichi, A. (CERN, Geneva). Nuovo Cimento (10), 40A: 589-96 (Nov. 21, 1965).

In connection with the proposals of Gell-Mann and Zweig on the possible origin of the SU_3 symmetry, an experiment was designed which is able to detect particles with electric charges $^2/_3$ in the cosmic radiation. The upper limit established by experiment is: quark per minimum ionizing incident particle $\leq 3 \times 10^{-6}$ with 90% confidence level. (auth)

7769 PERSISTENCE STUDY OF THE 27-DAY VARIATION OF INTENSITY OF COSMIC RADIATION. Zwanzig, W. (Univ., Halle, Ger.). Nuovo Cimento (10), 40A: 64-75 (Nov. 1, 1965). (In German).

Evidence was found for the existence of a persistent, a quasipersistent, and a pure statistical component of the 27-day variation of the cosmic-ray intensity from recordings at Huancayo, Christchurch, and Cheltenham stations from 1936 to 1956. The probability that the observed persistent wave could be simulated from the quasipersistent and pure statistical component was found to be approximately 4×10^{-3}. (tr-auth)

7770 LOW-ENERGY PRIMARY COSMIC-RAY NUCLEI OF CHARGES Z ≥ 6. Lim, Y. K. (Emmanuel Coll., Boston); Fukui, K. Nuovo Cimento (10), 40A: 102-20(Nov. 1, 1965).

A stack of nuclear emulsions exposed for 4.1 days under 2.1 g/cm^2 of matter in a recoverable satellite launched on August 29, 1963, into near polar orbits was scanned for ending tracks of cosmic-ray particles of charge Z ≥ 6. Charge identification was made by means of δ-ray counting, track area, and photometric track width measurements. Energy spectra were obtained for the M-nuclei ($6 \leq Z \leq 9$) in the (120 to 340) Mev/nucleon range, H-nuclei ($10 \leq Z \leq 19$) in the (130 to 500) Mev/nucleon range and VH-nuclei ($20 \leq Z$) in the (190 to 600) Mev/nucleon range. These spectra are similar to the differential energy spectrum of He nuclei reported for the same period, while the possibility of a shift in the intensity peaks of (~100 to 200) Mev/nucleon for the heavier components cannot be excluded. The abundance ratios are 0.28 ± 0.05 for (VH + H)/M in the energy range (200 to 350) Mev/nucleon and 0.40 ± 0.12 for VH/H in the range (200 to 400) Mev/nucleon. The results suggest that the role played by ionization in the passage of the primary heavy radiation from source to Earth's vicinity is relatively unimportant. On the consideration of ionization alone, the amount of interstellar matter traversed would be less than 4 g/cm^2. Alternatively, it may be assumed that most low-energy nuclei which may be expected to be modified by ionization have been removed by a solar modulating mechanism. (auth)

7771 SOME PROPERTIES OF THE RADIATION RECORDED BY THE IGY COSMIC-RAY NEUTRON MONITORS IN THE LOWER ATMOSPHERE. Bachelet, F.; Balata, P.; Iucci, N. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 40A: 250-60(Nov. 1, 1965).

A survey was carried out in 1964 near Rome from sea

level up to 1800 m altitude with a mobile neutron monitor of the IGY design mounted on a lorry. Both the monitor counting rate and the rates of events with different detected multiplicities were measured as a function of altitude, and the corresponding attenuation coefficients were deduced. The results are discussed together with those obtained in 1963 on the latitude effect of the different detected multiplicities, under the assumption that the muon contribution is a controlling factor of the counting rate of the IGY neutron monitors in the lower atmosphere. The dead-time dependence of the monitor response to variations of atmospheric pressure and primary spectrum is also studied. (auth)

7772 DIFFERENCES BETWEEN COSMIC-RAY INTENSITIES OBSERVED IN POLAR AND NONPOLAR REGIONS. **Kane, R. P. (Physical Research Lab., Ahmedabad, India). Nuovo Cimento (10), 40A: 710-22 (Dec. 1, 1965).**

The directions of maximum sensitivity in space for the neutron monitors in polar regions make large angles with the ecliptic plane in contrast with the neutron monitors at lower latitudes. Hence a comparison of the intensities recorded in the two regions would reveal differential changes, if any, between the cosmic-ray intensity level inside and outside the ecliptic plane. Such an analysis was carried out and revealed differences as large as ±2% in the daily means which were far outside the Poisson statistical errors. However, it was found that whereas the genuineness of some of these is not ruled out, a major part had to be attributed to unsatisfactory operation of instruments. This was so not only in the early part of I.G.Y. (1957) but even in 1963 and also for some super neutron monitors operating in 1964, thus nullifying to a great extent the advantages these would have had because of their high statistical accuracy. The need for operating at least three independent sections of a neutron pile and ensuring the parallel running of at least two of these all the time is emphasized. (auth)

7773 DETECTION OF RADIO PULSES FROM EXTENSIVE AIR SHOWERS, WITH A WIDE-BAND RECEIVING SYSTEM. **Porter, N. A.; Long, C. D.; McBreen, B.; Murnaghan, D. J. B.; Weekes, T. C. (University Coll., Dublin). Phys. Lett., 19: 415-17(Nov. 15, 1965).**

Radio pulses associated with extensive air showers of moderate size, whose properties also appear compatible with the coherent emission models were observed. These observations confirm previous observations of such radio pulses. A receiving system at somewhat higher frequency and with greater bandwidth was used, in conjunction with a particle detector which selected showers. The feasibility of wide-band operation was investigated by an experiment set up in a site with a relatively low artificial background. Showers were detected both with and without a plastic Cherenkov particle detector for selecting the events. It is concluded that radio pulses associated with air showers may be detected with a wide-band system, in the presence of some interference. The observations are in reasonable agreement with a coherent emission model, but could be due either to a negative excess in the showers or to geomagnetic effects. (J.F.P.)

7774 GEOMAGNETIC ACTIVITY AND DIURNAL VARATION OF COSMIC RAY NEUTRON INTENSITY. **Murty, D. S. R.; Nagabhushanam; Rao, K. Ramanuja (Osmania Univ., Hyderabad, India). Proc. Indian Acad. Sci., Sect. A, 62: 139-44(Sept. 1965).**

A study of the geomagnetic relation of the daily variation of cosmic ray neutron intensity, corrected for barometric pressure variation, at Uppsala, Sulphur Mountain, Climax, Huancayo, Buenos Aires and Mawson has been undertaken. The neutron data of the year 1961 are divided into four groups depending upon the value of the daily geomagnetic planetary index, C_p. The results show that while there are differences in the diurnal amplitude for the first three C_p groups, the amplitude gets enhanced for the highly disturbed group. Substantial phase shifts to earlier hours are also observed. The increase of the amplitude in the last C_p group with respect to other groups shows a latitude dependence. (auth)

Direct Energy Conversion

7775 (AD-622945) RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION. Quarterly Technical Progress Report No. 8, June 1–August 31, 1965. **Jackson, William D.; Brown, George A.; Kerrebrock, Jack L.; Stickney, Robert E. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Aug. 15, 1965. Contract AF 33(615)-1083. 34p. CFSTI $2.00 cy, $0.50 mn.**

A summary of research progress to date on energy conversion is given. Five detailed papers are presented on steam–water condensing ejector test facility, MHD channel flow velocity profiles and entry length, thermionic emission from a tungsten monocrystal in oxygen, characteristics of a pure alkali metal vapor plasma, and the Brayton cycle MHD power generation. (M.O.W.)

7776 (AD-624736) RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION. Quarterly Technical Progress Report No. 9, September 1, 1965–November 30, 1965. **Jackson, W. D.; Brown, G. A.; Kerrebrock, J. L. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Dec. 15, 1965. Contract AF33(615)-1083. 7p.**

Brief summaries of progress to date and further plans in each of the following areas of investigation are presented; liquid-metal MHD power generation, liquid-metal MHD generators, and alkali-metal MHD generators. (M.O.W.)

7777 (JUL-262-TP) DIE THERMIONISCHE DIODE ALS DIREKTUMWANDLER VON WAERME IN ELEKTRISCHE ENERGIE. (The Thermionic Diode as a Direct Converter of Heat to Electric Energy). **Niekisch, Ernst A.; Preuss, Eduard (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Apr. 1965. 134p. Dep. mn.**

A critical bibliographic study is made of the use of thermionic diodes as direct converters of heat to electric energy. The electron conduction in a vacuum diode is described. The thermionic diode and the magnetic triode as energy converter are then considered. Operational generators and their applications are discussed. 246 references are included. (J.S.R.)

7778 EXPERIMENTAL STUDY OF THE MHD POWER GENERATION. **Yamamoto, Mitsuyoshi; Kawahara, Norio (Tokyo Shibaura Electric Co., Ltd.). Nippon Kikai Gakkai-shi, 68: 841-8(June 1965). (In Japanese).**

The results of a study with the experimental MHD generator in Toshiba with a 7 Mw heat input are described. An outline of the generator is given: heat input, 7 Mw; fuel and seed, light oil and K-soap dissolved in the fuel; oxidant, gaseous oxygen; combustion gas flow rate, 800 g/s; maximum electrical output, 20 kw; and operation time, 5 min. The combustor is designed as a reaction motor, and the generator channel is constructed of MgO side-wall bricks and 20 pairs of graphite electrodes. The experiments were carried out with the gas flow varied from 300 and 800 g/s; at the maximum flow rate the no-load generator induced voltage exceeded 100 v. The results are discussed and compared with theoretical values. It was found that the one-dimensional hydraulic flow analysis of channel well represents the reality even in this scale of generator. The generator is being modified for ten times the present output. (auth)

7779 ANALYSIS OF THERMOELECTRIC MATERIALS FOR THE HIGH TEMPERATURE DIRECT CONVERSION OF NUCLEAR ENERGY. **Russcher, G. E. (Iowa State Univ., Ames). Nucl. Struct. Eng., 2: 341-54(Oct. 1965).**

An analytical technique is presented which may be used to predict and select high temperature thermoelectric materials, utilizing basic information on chemical com-

pounds in their family groupings. This technique is demonstrated, and proposed materials are analytically evaluated for conversion efficiency and nuclear system compatibility. The predicted range of conversion efficiencies is competitive with or superior to present techniques of nuclear energy conversion. High temperature thermoelectric materials are expected to be superior to conventional thermoelectric materials because of radiation effects annealing as well as higher conversion efficiency. (auth)

7780 NEW TRENDS IN THE DEVELOPMENT OF THERMOELECTRON EMITTERS (REVIEW). Tsarev, B. M. Radiotekkhn. Elektron., 10: 1555-73(Sept. 1965). (In Russian).

New areas in the application of thermoelectron emitters and the new demands placed on thermoelectron emitters are discussed. The characteristics of the modern trends in the investigation and development of thermoelectron emitters are given. New materials are reported. The unsatisfactory position of theoretical investigations is reported. In conclusion, a list of basic literature published on the question with inclusion of previous publications and little-known developments in the area of thermoelectron emitters are given. (tr-auth)

7781 DETERMINABLE QUANTITIES OF THE PLASMA CURRENT IN THE CESIUM ENERGY CONVERTER. Wagner, Siegfried (Technische Univ., Dresden). Wiss. Z. Tech. Univ. Dresden, 13: 203-8(1964). (In German).

The Boltzmann equation is used to calculate several properties of the Cs energy converter plasma current operating at the usual pressure of 1 torr. The conductivity, mobility, and diffusion constants in Cs at 1 torr are calculated; free path length of electrons in Cs vapor at 1 torr at 0°C as a function of E is calculated and compared with data obtained from experimental observations. Mobility is calculated for scattering by neutral atoms, by ions, and by a combined sample of these. The specific electrical resistance of Cs vapor at 1 torr is described taking into account scattering by neutral particles, thermally produced ions, and injection of electron-ion pairs. The heat conductivity of the converter is calculated, as are the differential thermopotential and the plasma current. Certain features of charge transport in the plasma are discussed in light of these calculations, with a treatment of known experimental values in the literature and the influence of these factors on the efficiency of the converter. (BBB)

7782 AUXILIARY SPACE POWER DEVICES. Barney, R. A.; Kendall, E. G.; Hove, J. E. (Aerospace Corp., El Segundo, Calif.). pp 338-63 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

Auxiliary space power systems and the manner in which energy from a particular source is converted into a form suitable for the performance of useful work are discussed. Batteries, fuel cells, solar cells, magnetohydrodynamic cells, thermoelectric cells, thermionic cells, mechanical systems, isotope heat sources, and the nuclear reactor heat sources SNAP and thermionic emitters are described. (19 references). (F.J.H.)

7783 NEGATIVE SPACE CHARGE NEUTRALIZATION BY AN AUXILIARY DISCHARGE ION SOURCE [Thesis]. Kaske, Alan D. Minneapolis, Univ. of Minnesota, 1965. 103p.

The experimental tube consists of a thermionic cathode, a perforated collector, and a discharge anode. The perforated element serves as the collector for the thermionic diode and as the cathode for the auxiliary discharge. Ions formed in a helium discharge between the perforated element and the anode are injected into the thermionic diode, and measurements of the current-voltage characteristics of the thermionic diode for various values of auxiliary discharge current were made. Measurements were first performed on vacuum and gas-filled diodes with no injected ion current; these experiments yielded data in good agreement with the appropriate power laws. Two main conclusions were drawn from the data relating to the gas-filled thermionic diode when ions are injected into the interelectrode space. First, the injected ion current produced a greatly increased collected current; this increase was attributed to the presence of ions trapped in the potential minimum region. Second, under certain experimental conditions, three more or less well defined voltage regions were obtained in the current-voltage characteristics. As the diode voltage was increased from zero, the slope of the current voltage characteristic was initially relatively large and then became small, or under some circumstances negative; finally, the slope again increased and, for small injected ion currents, approached the zero ion current characteristic. In order to explain the experimental results, a model describing the space charge density in the potential minimum region of the diode was constructed. The equation giving the total equilibrium ion density and Poisson's equation were solved simultaneously by means of a computer. From this computer solution, possible current-voltage characteristics were inferred. The experimental results exhibited several of the features predicted by the theoretical model. (Dissertation Abstr.)

7784 DIRECT ENERGY CONVERSION. Angrist, Stanley W. This Book is a Part of the Allyn and Bacon Series in Mechanical Engineering and Applied Mechanics. Boston, Allyn and Bacon, Inc., 1965. 440p. $11.95.

The physics of semiconductors; thermoelectric, thermionic, photovoltaic, and MHD generators; fuel cells; and other less well-exploited methods of direct energy conversion are treated in a fundamental manner. The processes by which energy in various forms is converted directly into electricity are described. No attempt is made to present rigorous mathematical solutions. (J.F.P.)

Elementary Particles and Radiations

See also Field Theory, Scattering Theory, and Symmetries

Refer also to abstract 7768.

7785 (GA-6712) PARTIALLY INELASTIC TWO-BODY COLLISIONS. Rothbart, G. B. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Oct. 27, 1965. Contract AT(04-3)-167. 13p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Theoretical expressions were derived in order to more fully understand experimental observations and to prepare optimum experimental conditions in which neutrons experience partially inelastic collisions. (M.O.W.)

7786 (INR-650/VI/PH) NUCLEAR INTERACTIONS OF VERY HIGH ENERGY WITH LARGE ENERGY TRANSFER INTO NEUTRAL PIONS. Babayan, Kh. P.; Brikker, S. I.; Grigorov, N. L.; Podgurskaya, A. V.; Saveleva, A. I.; Shestoperov, V. Ya.; Buja, Z.; Massalski, J.; Niziol, B. (Institute of Nuclear Research, Warsaw (Poland)). July 1965. 21p. Dep.

The experimental data were obtained using an apparatus of an area of 10 m^2 installed at Mt. Aragats (3200 m). The apparatus contained emulsion plates and ionization chambers. Nuclear interactions in which the neutral pions take a large fraction ($k_{\pi^0} \geq 0.6$) of the primary particle energy were observed. (auth)

7787 (JINR-E-2413) THE REAL PART OF THE ELASTIC π^-p, pp, AND pd SCATTERING AMPLITUDE IN THE ENERGY REGION 2-10 Gev. Chernev, Kh.; Dalkhazhav, N.; Devinski, P.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 8p. Dep. mn.

The real part of the elastic p-p, p-d, and p-n scattering amplitude is measured in the energy range 2 to 10 Bev. The results of measurements of π^-p scattering amplitude at the momentum of 3.5 Bev/c are also presented. (auth)

7788 (JINR-E-2440) NUCLEON-NUCLEON POTENTIAL WITH A SOFT CORE FOR THE $^1S_0$ STATE IN THE ENERGY REGION 0.17-310 Mev. Bystritskii, I.; Legar, F.; Ulegla, I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1965. 6p. Dep. mn.

Nucleon-nucleon potentials with a soft core, giving a good description of the energy dependence of the $^1S_0$ state phase shifts in elastic p-p and n-p scattering, are found. However, at low energies the simultaneous description of p-p and n-p scattering in the $^1S_0$ state with the help of a single potential is in disagreement with the experimental data. (auth)

7789 (JINR-P-2349) TENZOR POLYARIZATSII PRI RASSEYANII POLYARIZOVANNYKH NUKLONOV NA POLYARIZOVANNOI PROTONNOI MISHENI. (The Polarization Tensor in Scattering of Polarized Nucleons on a Proton Target). Bilenkaya, I.; Vinternits, P.; Legar, F.; Yanout, Z. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1965. 114p. Dep. mn.

The tensor components were calculated and discussed according to the phase shift data in the energy range 23.1 to 630 Mev. (auth)

7790 (JINR-P-2381) OB ODNOI VOZMOZHNOSTI OPREDELENIYA ELEKTROMAGNITNYKH FORM-FAKTOROV W-MEZONA. (On a Possibility of Determining Electromagnetic Form-Factors of the W-Meson). Doan-Nhuong (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 6p. Dep. mn.

The electromagnetic vertex of the intermediate meson with spin 1 depends on three unknown form-factors G_1, G_2, G_3. It is pointed out that on the basis of the experiments on polarized proton and antiproton annihilation it is possible to determine the values of these form-factors, i.e., the values of the anomalous magnetic and quadrupole electric moment of the W-meson. (auth)

7791 (JINR-P-2382) OBRAZOVANIE π-MEZONOV V REAKTSII NN → NNπ NA POLYARIZOVANNYKH NUKLONAKH V MODELI ODNOPIONNOGO OBMENA. (Pion Production in the N + N → N + N + π Reaction on Polarized Nucleons in the OPE Model). Nurushev, S. B.; Solovyanov, V. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 22p. Dep. mn.

Assuming that inelastic nucleon-nucleon interaction involving single pion production can be described by the one-pion exchange diagram a calculation is made of energy spectra and left-right asymmetry in pion emission by collisions of 600 Mev polarized protons with unpolarized target protons. The results of calculations are in quantitative agreement with experimental data on positive pion production in the pp → pnπ^+ reaction. (auth)

7792 (JINR-P-2393) NEUPRUGIE VZAIMODEISTVIYA CHASTITS PRI BOLSHIKH ENERGIYAKH. I. SOSTAV I MNOZHESTVENNOST VTORICHNYKH CHASTITS. (Inelastic Particle Interactions at High Energies. I. Composition and Multiplicity of Secondary Particles). Barashenkov, V. S.; Maltsev, V. M.; Patera I.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 70p. Dep. mn.

The experimental data available at present at T ≥ 0.8 Bev are reviewed. Detailed tables of these data and their theoretical analysis are given. (auth)

7793 (JINR-P-2397) REALNAYA CHAST AMPLITUDY UPRUGOGO π-N RASSEYANIYA Na NULEVOI UGOL I SECHENE PEREZARYADKI V OBLASTI VYSOKIKH ENERGII. (Real Part of Zero-Angle Elastic π-N Scattering Amplitude and Charge Exchange Cross Section at High Energies). Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 8p. Dep. mn.

More accurate results of calculation of the real part of elastic $\pi^\pm$-p forward scattering amplitude are given. The effect of the asymptotic behavior of the cross sections σ_{tot} ($\pi^\pm$-p) is discussed. A discrepancy with experimental data at 10 to 30 Bev is pointed out both in the energy dependence of the real part and in the difference sign of the real parts of the π^--p and π^+-p scattering amplitudes. (auth)

7794 (JINR-P-2399) PROGRAMMA IDENTIFIKATSII KANALOV REAKTSII (VARIANTY 10-10 I 10-20). (A Program for Identification of the Reaction Channels (Variants 10-10 and 10-20)). Ivanchenko, Z. M.; Luk'yantsev, A. F.; Moroz, V. I.; Makarenkova, A. D.; Tentyukova, G. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1965. 30p. Dep. mn.

This program is designed to single out, by the least squares method, the most probable hypothesis about nuclear and elementary-particle interactions occurring in a given process, and for specifying track parameters. The program can be easily adapted to analyze data obtained with any beam and in any chamber. (auth)

7795 (JINR-P-2400) MEZONNYE REZONANSY 2^+, 1^+, 0^+ V TEORII VYSSHIKH SIMMETRII. (Meson Resonances 2^+, 1^+, 0^+ in the Higher Symmetry Theory). Ti, Kao; Nguyen van Hieu; Sredniava, Bronislaw (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 34p. Dep. mn.

Mesons of spin and parity 2^+, 1^+, 0^+ in SU(6) theory and its relativistic generalizations are considered. The connection between the representations 225 and 441 of the group U(6) and the representations 4212^+ and 5940^+ is explained with the aid of the scheme GL(6). It is shown that meson resonances A_2, K_π, and f_0 may belong to the representation 4212^+ as well as to 5940^+. Explicit expressions are given for the decay widths of all 2^+ mesons and the matrix elements for 1^+ and 0^+ mesons with particular values of isospin and hypercharge. (auth)

7796 (JINR-P-2407) TENZOR SPINOVOI KORRELYATSII PRI RASSEYANII POLYARIZOVANNYKH NUKLONOV NA PROTONNOI POLYARIZOVANNOI MISHENI. (Spin Correlation Tensor in the Scattering of Polarized Nucleons on a Polarized Proton Target). Winternitz, P.; Legar, F.; Yanout, Z. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1965. 40p. Dep. mn.

Experiments concerning the spin correlation tensor C in the scattering of polarized nucleons on polarized nucleons are discussed. Relativistic formulas are derived for the experimental quantities. Components of C are predicted for the energies 23.1, 40, 52, 95, 147, 210, 310, 400, and 630 Mev on the basis of various sets of phase shifts, and are given on graphs. The scattering matrix is directly reconstructed with the help of experimentally measured quantities. (auth)

7797 (JINR-P-2439) PRAVILA SUMM DLYA POGLOSHCHENIYA FOTONOV NUKLONAMI I MAGNITNYI MOMENT PEREKHODA N → $N^*_{3,3}$ V MODELI KVARKOV. (Sum Rules for Photon Absorption by Nucleons and the Magnetic Moment for the Transition N → $N^*_{3,3}$ in the Quark Model). Gerasimov, S. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 6p. Dep. mn.

Dipole sum rules for photon absorption by nucleons are obtained within the nonrelativistic quark model. Some qualitative properties of the energy dependence of the cross sections of the electric dipole and magnetic dipole photon absorption are pointed out. The Beg, Lee, and Pais formula for the magnetic moment of the transition N → $N^*_{3,3}$ is compared with experiment. It is shown that the divergence between theory and experiment is about 10%. (auth)

7798 (NEIC-RR-18) NEW PROPOSALS OF NEUTRINO EXPERIMENTS. Kuchowicz, B. (Nuclear Energy Information Center, Warsaw (Poland)). 1965. 42p. Dep.; $2.00 cy, $0.50 mn.

The results of the most important experiments with free neutrinos and antineutrinos are listed. Also some other ex-

periments being now in progress are mentioned. Four interesting proposals are reviewed; the application of salt deposits as traps for solar neutrinos (the use of Pontecorvo-Davis reaction), the production of an artificial neutrino source by irradiation in a reactor, the use of pulse reactors (also with lithium being irradiated) as sources of antineutrinos, and the experimental detection of antineutrinos from underground explosions of nuclear devices. Some other ideas dealing with the detection of antineutrinos were surveyed. (auth)

7799 (PPAD-571F) POSITRON MOMENTUM SPECTRUM FROM K^+_{e3} DECAY [Thesis]. Eschstruth, Paul T. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Oct. 1, 1965. Contract AT(30-1)-2137. 111p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

In the decay $K^+ \rightarrow \pi^0 + e^+ + \nu$, the positron momentum spectrum is measured in the range 60 to 230 Mev/c, using stopped K^+ mesons from a 47° beam at the Princeton-Pennsylvania accelerator. The positrons are identified with a gas Cherenkov counter and their momentum measured with a standard deviation of approximately 2 percent by means of thin-plate spark chambers situated in a magnetic field between the Cherenkov counter and the stopping region. The experimental distribution, containing 1850 events, is consistent with that to be expected for vector coupling. Upper limits for scalar and tensor admixtures (in terms of intensity) are found to be 10 and 2 percent respectively. The K^+_{e3} branching ratio is calculated to be (5.42 ± 0.34) percent. (auth)

7800 (TID-22396) PARTICLE DATA FOR MESIC HYPERNUCLEI. Technical Report No. 501. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Sept. 1965. Contract AT(40-1)-2504. 46p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Tabulations of particle data for all mesonically decaying hypernuclei observed by the Nuclear Emulsion Group at Maryland are presented. Particle ranges given are as measured and are not normalized to standard emulsion densities. (M.O.W.)

7801 (UCRL-16362) BRANCHING RATIOS IN K^+ MESON DECAY [Thesis]. Young, Poh-shien (Lawrence Radiation Lab., Univ. of California, Berkeley). Sept. 15, 1965. Contract W-7405-eng-48. 77p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A comprehensive study of the branching ratios in K^+ meson decay was carried out by reviewing previous work and performing a new experiment. For this research a beam of 10^6 K^+ mesons was brought to rest in a volume of 14 cc within a large stack of nuclear emulsions. The stack was designed so that the secondaries of the longest range could be followed to rest if the directions of their emission lie within certain cones. Some 700 K^+ decays for which each secondary was emitted in the selected cones were chosen as the sample for the experiment. The principal method for identifying the secondaries was following the track to rest, thus avoiding many sources of systematic error. Ionization measurements were used to resolve ambiguities. The overall efficiency for finding events was found to be higher than 95% and the relative efficiencies for the various modes were evaluated. The corrected branching ratios for the $K_{\mu 2}$, $K_{\mu 3}$, $K_{\pi 2}$, τ, τ', and K_{e3} were found to be 61.8 ± 2.9, 5.4 ± 0.9, 19.3 ± 1.6, 6.0 ± 0.4, 2.3 ± 0.6, and 5.3 ± 0.9 respectively. (auth)

7802 (UCRL-16473) K DECAY. Trilling, George H. (Lawrence Radiation Lab., Univ. of California, Berkeley). Nov. 17, 1965. Contract W-7405-eng-48. 46p. (CONF-651043-3). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Weak Interactions Conference, Argonne, Ill.

A critical survey of measured K-meson decay modes is presented. The accuracies of results are evaluated. The agreement between the experimental data and theoretical predictions is discussed. 68 references. (T.F.H.)

7803 (AEC-tr-6662) EXPERIMENTAL RESULTS ON BEAM-BEAM INTERACTION. Kulipanov, G. N; Naumov, A. A.; Popov, S. G.; Skrinsky, A. N.; Tumaikin, G. M. Translation of Paper Presented to the International Conference on High Energy Accelerators, Frascati, Italy, September 3-14, 1965. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf.

Electromagnetic effects in electron-electron colliding-beam experiments in the VEP-1 device are studied. The beams studied are contained in storage rings, and have energies of 43 Mev. (T.F.H.)

7804 MASSES OF THE METASTABLE PARTICLES. Barkas, Walter H. (Univ. of California, Riverside). Ann. Rev. Nucl. Sci., 15: 67-88(1965).

A review is given of measurements on particles which undergo weak and electromagnetic decay. Measurements of the mass of the antiproton, which is a stable particle of special interest, are also included. Particle states which undergo strong decay are omitted. The theoretical bases for the mass measurements are discussed. (L.B.S.)

7805 SPIN AND PARITY DETERMINATION OF ELEMENTARY PARTICLES. Tripp, Robert D. (Univ. of California, Berkeley, CERN, Geneva). Ann. Rev. Nucl. Sci., 15: 325-80(1965).

A review is presented on methods and results of spin and parity determinations of elementary particles. Particular emphasis is placed on the more recently discovered unstable states, which decay by strong interactions, although metastable states, which decay by electromagnetic or weak interactions, and energetically stable states are also discussed. The various elementary-particle states are tabulated along with symbolic indications of the methods used for their spin and parity determinations. (L.B.S.)

7806 WEAK INTERACTIONS. Lee, T. D.; Wu, C. S. (Columbia Univ., New York). Ann. Rev. Nucl. Sci., 15: 381-476(1965).

A critical and comprehensive survey of the theoretical aspects of weak interactions is presented in general discussions on exact symmetry properties, the effective lagrangian and its selection rules, and the possible existence of the intermediate boson. Experiments and phenomenological analysis dealing with leptonics reactions in beta decay, muon decay, muon capture, and pion decays are discussed. (L.B.S.)

7807 ELECTROMAGNETIC PROPERTIES OF K_0 AND THE MODE $K^2_0 \rightarrow 2\pi$. Jouvet, Bernard (Coll. of France, Paris). Compt. Rend., 261: 3299-3302(Oct. 27, 1965). (In French).

The usual field theory predicts the existence of a finite and noninvariant gauge interaction of neutral particles with photon pairs. The existence of nonzero electric beam of K_0's entails then that these have the small calculated charge $\epsilon_{K_0} \cong E \times 10^{-3}$. This permits the quantitative explanation of the observed mode $K^2_0 \rightarrow 2\pi$. The violations of principles that this theory entails are discussed, and various means of verifying it are proposed. (tr-auth)

7808 MOTION OF A CHARGED PARTICLE IN A PLANE ELECTROMAGNETIC WAVE. Anderson, N. (Univ. of York, Eng.). Int. J. Electron., 19: 197-9(Aug. 1965).

The motion of a charged particle in a plane electromagnetic wave is considered. It is assumed that the frequency of the wave is low enough for the trajectory of the particle to be obtained from the Newtonian equation of motion with the Lorentz force included. Thus scattering effects and the radiation reaction are not included in the problem. (auth)

7809 THE ROLE OF NEUTRAL LEPTON CURRENTS IN NEUTRINO (ANTINEUTRINO)-ELECTRON SCATTERING. Romanov, Yu. I. (Inst. of Medical Radiology, Academy of Medical Sciences, USSR). Izv. Vyssh. Ucheb. Zavendenii, Fiz., No. 4, 176-8(1965). (In Russian).

The cross section of the νe and $\bar{\nu} e$ scattering, using the hamiltonian of the four-fermion (V,A) interaction and taking into account the polarization of the target and of the recoil electrons was previously calculated. This problem was

further examined by determining the differential and the total νe and $\bar{\nu} e$ scattering cross sections under conditions of fixed longitudinal polarization of the spin of the neutrino or antineutrino before and after the scattering by means of the composite (V,A) interaction, involving neutral lepton currents. The Feynman–Gell-Mann scheme was used for the derivation. It was concluded that a stable correlation between the spin of the neutrino (antineutrino) and its pulse is obtained only in the case of the V-A variant of the interaction; in the V + A case scattering may occur only if the spin of the neutrino (antineutrino) is inverted. (TTT)

7810 ELASTIC PHOTOPRODUCTION OF π^0 MESONS FROM DEUTERIUM IN THE ENERGY RANGE FROM 500 to 700 Mev. Miyake, K.; Baba, K.; Hatano, S. (and others). (Kyoto Univ.). J. Phys. Soc. Jap., 20: 1749-57(Oct. 1965).

The reaction, $\gamma + d \rightarrow d + \pi^0$, was used to measure the isotopic vector part of the photopion production amplitude from nucleons around the second resonance. The differential cross sections were measured at 57.6° (lab) for E_γ = 500 ~ 700 Mev. The momentum of recoil deuterons was analyzed with a magnet and their flight time was measured with a time-to-pulse height converter, to discriminate deuterons from protons and pions. The measured cross sections were analyzed in terms of the π-N phase shifts basing on the impulse approximation. The $s_{\overline{3}}$, $s_{\overline{1}}$, $p_{\overline{33}}$, $p_{\overline{11}}$ and $d_{\overline{13}}$ phase shifts are included in this analysis. The measured cross sections are in fairly good agreement with the calculation. However, the cross sections calculated in the absence of the $d_{\overline{13}}$-wave are smaller by about 40% than the measured ones. The results of analysis are consistent with the assumption that the $d_{\overline{13}}$ wave amplitude of photoproduction from free nucleons is an isotopic vector. (auth)

7811 RADIATIVE CORRECTIONS TO $\pi \rightarrow \gamma + \mu + \nu$ AND THE NEUTRETTO MASS. Kamal, A. N. (Univ. of Alberta, Edmonton, Can.). Nuovo Cimento (10), 40A: 424-33(Nov. 21, 1965).

Radiative corrections to the radiative π decay are shown to be negligibly small. The negligible smallness of the radiative corrections is not a general feature of the three-body decays of the kind $A \rightarrow B + C + \nu$. It is shown, with the leptonic K decay as an illustration, that the radiative corrections are significantly large if the charged lepton in the final state can become relativistic. (auth)

7812 SPIN AND PARITY OF Y_1^* IN THE ONE-PARTICLE EXCHANGE MODEL. Gupta, Y. M.; Agarwal, B. K. (Allahabad Univ., India). Nuovo Cimento (10), 40A: 434-49(Nov. 21, 1965).

The production of Y_1^* is studied in K^--p collisions by using the one-particle exchange model. By comparing the calculated results with the experimental data under various constraints, it is possible to conclude that the most consistent spin-parity assignment of Y_1^* is $3/2^+$. (auth)

7813 INELASTIC CONTRIBUTIONS TO THE LOW-ENERGY K^+-PROTON SCATTERING. Campogalliani, P.; Paccanoni, F. (Univ., Padua). Nuovo Cimento (10), 40A: 486-91(Nov. 21, 1965).

An effective-range approach to the low-energy K^+-proton scattering which includes inelasticity effects is considered. By taking into account these features of the K^+-p interaction, it is possible to obtain self-consistent results avoiding ghosts present in previous treatments. (auth)

7814 N* PRODUCTION IN HIGH-ENERGY π-p AND K-p COLLISIONS BY REGGE-POLE EXCHANGE MODEL. Roy, D. P. (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 40: 513-22(Nov. 21, 1965).

The reactions $K^+p \rightarrow K^0 N^{*++}$, $\pi^+p \rightarrow \pi^0 N^{*++}$, and $\pi^+p \rightarrow \omega N^{*++}$ are studied using the ρ Regge-pole exchange mechanism. The values of the ρ trajectory $\alpha(t)$ are taken from the π^--p charge exchange scattering data, and the t-dependence of the residues is neglected. Then the latter are obtained in terms of the field-theoretic coupling constants using the fact that Regge-pole exchange is identical to the corresponding elementary-particle exchange at the pole point. Thus the production cross sections are obtained in terms of these coupling constants and do not involve any other unknown parameters. The coupling constants are then determined by normalizing the total cross section for each reaction to the experimental value at a given energy and are shown to agree with existing estimates. Finally the energy and momentum-transfer dependence of the three production cross sections are analyzed and are found to be in broad agreement with experiment. (auth)

7815 INELASTIC MUON INTERACTIONS IN NUCLEAR EMULSION AT 2.5 AND 5.0 Gev. Kirk, J. A.; Cottrell, D. M.; Lord, J. J.; Piserchio, R. J. (Univ. of Washington, Seattle). Nuovo Cimento (10), 40A: 523-41(Nov. 21, 1965).

The inelastic scattering of high-energy muons from emulsion nuclei was measured with the use of monoenergetic beams of 2.5 and 5.0 Bev/c muons. Ilford G-5 stacks were exposed perpendicularly to the beam, and Ilford K-5 stacks were exposed parallel to the beam. Area scanning resulted in a total of 135 events with four-momentum transfers greater than 26 Mev/c. The observed scattering distribution which extends up to 10 degrees, or a momentum transfer of about 900 Mev/c, is in good agreement with the predictions of the electromagnetic theory assuming single-photon exchange. There were also observed four events with scattering angles greater than 10 degrees which are not inconsistent with the theory. Pion production was observed with the major contribution coming from the $3/2$, $3/2$ resonance. The cross sections for this process were found to be (3.6 ± 0.7) and (5.1 ± 0.5) microbarn for muon momenta of 2.5 and 5.0 Bev/c, respectively. Events involving much lower energy exchanges were found to have much larger cross sections and were consistent with giant-resonance photodisintegration observations. (auth)

7816 AN APPLICATION OF THE ABSORPTION MODEL TO THE REACTIONS $p\bar{p} \rightarrow Y\bar{Y}$. Hoegaasen, H.; Hoegaasen, J. (CERN, Geneva). Nuovo Cimento (10), 40A: 560-75(Nov. 21, 1965).

A set of calculations of the reaction $p\bar{p} \rightarrow Y\bar{Y}$ in the antiproton laboratory momentum range from 3 to 7 Bev/c is presented. The process is assumed to take place through K* exchange only, and the calculations are performed within the framework of the absorption model (the distorted wave Born approximation). A good description of the angular dependence of the cross section is obtained for the three channels $\Lambda\bar{\Lambda}$, $\Lambda\bar{\Sigma}^0 + \bar{\Lambda}\Sigma^0$, and $\Sigma^+\bar{\Sigma}^+$ in the whole energy range. However, the energy dependence is wrong, and appears the worst for the channel $\Lambda\bar{\Lambda}$, where the angular dependence is best described. (auth)

7817 ANALYTIC COMPLETION AND π-N SCATTERING. Joshi, G. C. (Univ. of Delhi). Nuovo Cimento (10), 40A: 630-3(Nov. 21, 1965).

The problem of analytic continuation of the Froissart-Gribov representation of the relativistic partial-wave amplitude is discussed in the case of pion-nucleon scattering. Equations for the partial-wave amplitude are written, and the asymptotic behavior of the spectral functions is considered. The partial-wave amplitude is found to be a meromorphic function of complex J in a region defined by assumptions on the asymptotic growth of the spectral functions. (M.J.T.)

7818 THE 720 Mev S-WAVE π-π RESONANCE AND THE ONE-BOSON EXCHANGE MODEL OF N-N SCATTERING. Kikugawa, M. (Hiroshima Univ.); Sawada, S.; Yonezawa, M.; Ueda, T.; Watari, W. Nuovo Cimento (10), 40A: 647-9(Nov. 21, 1965).

It is pointed out that the recently reported I = 0, $J^P = 0^+$ π-π resonance with mass ~720 Mev and width ~50 Mev may be the scalar meson predicted by the one-boson exchange (OBE) model of N-N scattering. Discrepancies between the predicted mass for this unitary singlet and the observed mass are discussed. The possibility that the observed resonance may be part of the 0^+ triplet or the 0^+ octet is also considered. The relation of the S-wave

scalar meson predicted by the OBE model to the behavior of the π-N scattering length and phase shift is discussed. (M.J.T.)

7819 ELASTIC ν_μ-p SCATTERING. Williamson, W. Jr.; Kummer, M. (Univ. of Michigan, Ann Arbor). Nuovo Cimento (10), 40A: 650-3(Nov. 21, 1965).

The total cross section for the process $\nu_\mu + p \rightarrow \nu_\mu + p$ is calculated, assuming that both induced and direct coupling weak neutral currents exist. Results are given for the cases when the direct neutral current mediated by a neutral vector meson (W^0) is dominant, the induced neutral current (photon exchange) is dominant, and the two processes are comparable. The calculation extends to incident neutrino energies of about $1.3m_p$, and the W^0 rest mass is taken to be $3m_p$. Expressions for the cross sections are found from the equations for the amplitudes of the elastic scattering with photon exchange and with W^0 exchange and are integrated by graphical methods. The results are not encouraging from the point of view of experimental testing. (M.J.T.)

7820 DECAYS OF HIGHER BOSON RESONANCES IN THE $\tilde{U}_{12}$ KINETIC SUPERMULTIPLET SCHEME. Maiani, L. (Istituto Superiore di Sanita, Rome); Preparata, G. Nuovo Cimento (10), 40A: 654-8(Nov. 21, 1965).

The rates of decay of some of the particles assigned to the lowest $\tilde{U}(12)$ boson kinetic supermultiplet, represented by reducible $\tilde{U}(12)$ tensors in the broken U(12) symmetry, are calculated and compared with data. The particle assignments previously proposed in this classification are reviewed, and the formulas relevant to the calculations are reported. The kinetic boson supermultiplet is described by a product of an irreducible tensor of the representation 143 of $\tilde{U}(12)$ and a kinetic tensor. The couplings and matrix elements are formed for the decay of a component of the 2^{++} nonet into two mesons of 143 (pseudoscalar and vector mesons). Calculated partial decay widths are given for various decay modes of the mesons f*(1520), f^0(1253), A(1310), and K*(1400), and the resulting branching ratios are compared with experimental values. (M.J.T.)

7821 THE LEPTONIC ANNIHILATION MODES OF THE PROTON-ANTIPROTON SYSTEM AT 6.8 (Gev/c)^2 TIMELIKE FOUR-MOMENTUM TRANSFER. Conversi, M.; Massam, T.; Muller, Th.; Zichichi, A. (CERN, Geneva). Nuovo Cimento (10), 40A: 690-701(Nov. 21, 1965).

Experiments on the processes $\bar{p} + p \rightarrow \bar{e} + e$ and $\bar{p} + p \rightarrow \bar{\mu} + \mu$ were carried out at 2.5 Bev/c. The electromagnetic form factors for timelike four-momentum transfers were measured, and the equivalence of the electromagnetic interactions of the electron and the muon for timelike four-momentum transfers was checked. The experimental set-up, consisting of incident beam telescope, polyethylene target, spark chambers, discrimination Cherenkov counters, muon telescopes of lead absorbers and counters, and electron telescopes of lead absorbers, spark chambers, and scintillation counters, is described, and the calibration is discussed. Rejection of background events is described. Results are given for angular distributions, total cross sections, and form factors, for the electron, muon, and total-lepton channels and for various assumptions on the electron and muon form factors. (M.J.T.)

7822 VIRTUAL PION-NUCLEON SCATTERING. Selleri, F. (Cornell Univ., Ithaca, N. Y.). Nuovo Cimento (10), 40A: 236-49(Nov. 1, 1965).

The problem of pion-nucleon scattering when the initial pion is virtual is discussed with the aid of one-dimensional dispersion relations, under the usual assumption that the dispersive integrals are dominated by the $I = J = 3/2$ partial-wave amplitude. The problem of obtaining the off-shell behavior of the latter amplitude is considered by avoiding certain approximations which had been used previously. The improvements are important at high momentum transfer. The other partial-wave amplitudes were calculated and in particular a large $S_{1/2}$ amplitude with $I = 1/2$ was obtained. The significance of this result in certain production processes is discussed. (auth)

7823 QUASI-TWO-BODY PROCESSES IN THE REACTION $\pi^+p \rightarrow p\pi^+\pi^+\pi^-\pi^0$ AT 2.75 Gev/c. Armenise, N. (Univ., Bari, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy); Ghidini, B.; Picciarelli, V.; Romano, A.; Kayas, G.; Laberrigue-Frolow, J.; Tridon, J.; Vigneron, L.; Yiou, T. P. Nuovo Cimento (10), 40A: 273-80(Nov. 1, 1965).

The experimental results concerning the reaction $\pi^+p \rightarrow p\pi^+\pi^+\pi^-\pi^0$ and particularly the channels $\pi^+p \rightarrow N^{*++} + \omega$ and $\pi^+p \rightarrow p + (\pi^+ + \omega)$ are presented. An attempt was made to explain the $N^{*++} - \omega$ production by a peripheral mechanism involving one-meson exchange. The behavior of the $\omega - \pi$ system was investigated in search for evidence of the B-resonance. (L.B.S.)

7824 $U_{(6,6)}$ SYMMETRY AND HIGHER BARYON RESONANCES. Volkov, D. V. (CERN, Geneva). Nuovo Cimento (10), 40A: 284-6(Nov. 1, 1965).

The consequences which follow from the assignment of the ladder representation of the $U_{(6,6)}$ algebra to the higher baryonic resonances for the interaction of these resonances with the (56,1) baryonic and the $(6,\bar{6})$ mesonic $SU_6 \times SU_6$ multiplets are considered. Branching ratios are obtained for the decay of the states with $j = 3/2 + n$ into the octet of pseudoscalar mesons and the baryons of the (56,1) $SU_6 \times SU_6$ representation, and also the decays of the states with $j = 1/2 + n$ into the octet of pseudoscalar mesons and the octet of baryons. (L.B.S.)

7825 COLLINEAR PHOTOPRODUCTION IN THE SU_{6W} SYMMETRY MODEL. Kupsch, J. (Univ., Bonn). Nuovo Cimento (10), 40A: 287-94(Nov. 1, 1965).

The photoproduction processes, $\gamma + \mathcal{N} \rightarrow P + N$, $\gamma + \mathcal{N} \rightarrow V + N$, and $\gamma + \mathcal{N} \rightarrow P + D$, are considered in the SU_{6W} symmetry group of Lipkin and Meshkov ($\mathcal{N}$: nucleon, N: $1/2^+$ baryon, D: $3/2^+$ baryon, P: 0^- meson, V: 1^- meson). The group includes spin and unitary spin in a relativistic invariant manner for collinear processes. Relations are derived between the amplitudes and for differential cross sections. The coefficients of the amplitudes are tabulated. (L.B.S.)

7826 A POSSIBLE MODEL FOR NUCLEON-ANTINUCLEON ANNIHILATION. Minami, S. (Osaka City Univ.). Nuovo Cimento (10), 40A: 299-302(Nov. 1, 1965).

The following model is suggested for the process $N + \bar{N} \rightarrow nb$, where b denotes a boson: in p-$\bar{p}$ annihilation at rest or a low energy, a π^+ or a π^0 (a π^- or a π^0) is emitted from the pion cloud of the proton (the antiproton), and a vector meson (ρ, ω, or φ) is produced by the annihilation of a nucleon core and an anti-nucleon core. K-$\bar{K}$ pairs are then observed mainly as the decay products of φ-mesons. Conclusions concerning the characteristic properties of the reaction are discussed. (L.B.S.)

7827 K* ISOBAR IN THE ONE-PARTICLE EXCHANGE MODEL. Watal, C.; Gupta, Y. M.; Agarwal, B. K. (Univ. of Allahabad, India). Nuovo Cimento (10), 40A: 303-7(Nov. 1, 1965).

The Kπ resonant state, produced in three different reactions, was studied according to the one-particle exchange model. The agreement between the theoretical predictions and experiment was found to be reasonably good. For K^--p collisions the exchange appears to satisfy several constraints. In K^--p and π^--p collisions it was found that the usually ignored fermion exchange diagrams may play an important role. (L.B.S.)

7828 NOTE ON WEAK RADIATIVE HYPERON DECAYS. Ademollo, M.; Buccella, F.; Gatto, R. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence). Nuovo Cimento (10), 40A: 316-18(Nov. 1, 1965).

A brief discussion is presented on weak radiative decays of hyperons in $SU_6(W)$, $SU_6(S)$, and in collinear $SU_3 \otimes SU_3$ together with some consequences of CP invariance in each case. (L.B.S.)

7829 SOME REMARKS ON THE $\gamma + \gamma \rightarrow \nu + \bar{\nu}$ PROCESS. Boccaletti, D. (Univ., Modena, Italy); de Sabbata, V.; Gualdi, C. Nuovo Cimento (10), 40A: 705-9(Dec. 1, 1965).

The effects of derivative terms in the leptonic current of the $\gamma + \gamma \rightarrow \nu + \bar{\nu}$ reaction are considered. It is shown that these terms give a nonzero contribution, and an upper limit for the cross section is estimated. (auth)

7830 THE UNITARY SUM RULE AND THE THRESHOLD BEHAVIOR OF THE DYNAMICAL FUNCTION. Caprasse, H. (Service de Physique Mathematique, Liege). Nuovo Cimento (10), 40A: 723-38(Dec. 1, 1965).

Consistency relations of the partial-wave dispersion relations are derived which are valid under rather weak hypotheses on the forces and in particular without any assumption on their threshold behavior. They are applied to a discussion of the consistency of the l = 2 wave of a scalar version of the nucleon exchange model in π-Λ scattering and the l = 1 wave of the ρ exchange model in π-π scattering. Some interesting results such as a clarification of the role played by the numerator of the kinematical factor which multiplies the π-Λ partial-wave amplitude and an evaluation of the contribution of the short-range forces in π-π scattering are obtained. (auth)

7831 ON THE PRINCIPLE OF SUPERPOSITION IN K^0 DECAYS. Laurent, B. (CERN, Geneva. Univ. of Stockholm); Roos, M. Nuovo Cimento (10), 40A: 788-802 (Dec. 1, 1965).

Two alternatives for explaining the anomalous CP-nonconserving 2π decays of K^0 mesons are discussed: the linear theory, violating CP invariance, and a CP-invariant, nonlinear theory, violating the principle of superposition. Experiments are proposed to distinguish between these two possibilities. (auth)

7832 ELECTROMAGNETIC CORRECTIONS TO MUON AND BETA DECAYS WHEN MEDIATED BY A VECTOR BOSON. II. Bailin, D. (Clarendon Lab., Oxford). Nuovo Cimento (10), 40A: 822-38(Dec. 1, 1965).

The results of a previous paper are generalized to include vector bosons having arbitrary magnetic dipole moment and electric quadrupole moment. The increased divergence inherent in such terms is reflected in the results for the electron energy spectrum from muon decay and in the muon lifetime, both of which are cut-off dependent. After the inclusion of the corrections to beta decay the conserved vector current hypothesis gives the prediction for the muon lifetime in terms of the ft value for ^{14}O. While this predicted value still depends upon the cut-off, the dependence vanishes in the limit of the boson mass becoming infinite. In this limit the boson mass provides an effective cut-off. (auth)

7833 PERIPHERAL PRODUCTION OF N*(1518) $\rightarrow p\pi^+\pi^-$ AND N*(1688) $\rightarrow p\pi^+\pi^-$ RESONANCES IN pp $\rightarrow pp\pi^+\pi^-$ REACTION AT 5.5 Gev/c. Alexander, G. (Weizmann Inst. of Science, Rehovoth, Israel); Benary, O.; Haber, B.; Kidron, N.; Shapira, A.; Yekutieli, G.; Gotsman, E. Nuovo Cimento (10), 40A: 839-45(Dec. 1, 1965).

The reactions pp $\rightarrow$ pp $\rightarrow$ pN*(1518) $\rightarrow pp\pi^+\pi^-$ and pp $\rightarrow$ pN*(1688) $\rightarrow pp\pi^+\pi^-$ at 5.5 Bev/c were studied. Total and differential cross sections were calculated with the unmodified and modified (absorptive) one-pion exchange (OPE) models using explicit wave functions for the spin-$^3/_2$ and spin-$^5/_2$ particles. Agreement between the experimental and calculated angular distributions is attained with the absorption modification to the OPE model. (auth)

7834 CALCULATION OF THE PROCESS $\pi^-p \rightarrow (N^*) \rightarrow 1^-1^+n$ FOR THE FIRST FOUR BARYON RESONANCES. Kessler, P. (College of France, Paris). Nuovo Cimento (10), 40A: 887-98(Dec. 1, 1965). (In French).

The differential cross sections for the processes $\pi^- + p \rightarrow (\Lambda^{*0}) \rightarrow 1^- + 1^+ + n$, where Λ^* is any of the first four baryonic resonances ($^3/_2^+$, $^3/_2^-$, $^5/_2^+$, $^7/_2^+$), are calculated through a triple factorization procedure. The interest and difficulties of this type of experiment (in particular at the energy of the $^7/_2^+$ resonance) are discussed. (auth)

7835 THE RATE OF THE RADIATIVE DECAY $\Sigma^+ \rightarrow p + \gamma$. Quareni, G. (Univ., Bologna); Vignudelli, A. Quareni; Cartacci, A. M.; Dagliana, M. G.; Della Corte, M.; Tomasini, G.; Gainotti, A.; Lamborizio, C.; Mora, S.; Ortalli, I. Nuovo Cimento (10), 40A: 928-34 (Dec. 1, 1965).

From the analysis of ~3000 decays at rest of Σ^+'s into protons the branching ratio $R = (\Sigma^+ \rightarrow p + \gamma)/(\Sigma^+ \rightarrow p + \pi^0)$ was determined. Its order of magnitude is 10^{-3}. This result was obtained by using photographic emulsions, which were exposed to a slow K beam of the CERN proton synchrotron. By adding the new data to those of a previous work, for which the same criteria were used, a branching ratio of $R = 1.7 \times 10^{-3}$ is obtained. In addition, two anomalous events were observed which belong very likely to the decay mode $\Sigma^+ \rightarrow p + \pi^0 + \gamma$. (auth)

7836 A STUDY OF 6.1 Gev/c π^- INTERACTIONS IN A HEAVY-LIQUID BUBBLE CHAMBER. Bellini, G.; di Corato, M.; Duimio, F.; Fiorini, E. (Univ., Milan). Nuovo Cimento (10), 40A: 948-78(Dec. 1, 1965).

A systematic study was carried out at various multiplicities on H-like and N-like interactions produced by 6.1 Bev/c mesons in a bubble chamber filled with a mixture of propane and CF_3Br. The total multiplicity of events was obtained by determining the number of charged and neutral pions emitted. Results on the population of events in the various categories and on the angular and invariant mass distributions are compared with the predictions of the existing models of high-energy interactions. While these results are found to be in excellent agreement with the statistical model for events with six or more emitted pions, a strong contribution by peripheral processes exists at lower multiplicities. In addition to the one-pion-exchange mechanism contributions of ρ exchange and Drell and Hiida diffraction seem relevant for events with pion multiplicity equal to two. Nuclear interactions, where the complex nucleus acts coherently, are present at all multiplicities up to five; this effect is particularly strong in the reactions where three pions are emitted. A bump between 1600 and 1800 Mev appears in the mass distribution of the events with four emitted pions. The values of the average transverse momenta of the secondaries at various multiplicities are reported. (auth)

7837 GENERATED UNITARITY RELATIONS FOR MULTICHANNEL SCATTERING AMPLITUDES. Masuda, N. (Nihon Univ., Tokyo); Kawai, T. Nuovo Cimento (10), 40A: 979-84(Dec. 1, 1965).

The coupled two-channel processes $\pi + N \rightleftharpoons \pi + N$, $\pi + N \rightleftharpoons \pi + \pi + N$, and $\pi + \pi + N \rightleftharpoons \pi + \pi + N$, where all particles are assumed to be scalar and isoscalar, are treated. The coupled unitarity relations for the interactions are used to derive coupled integral equations which are solved by application of time reversal invariance and comparison with the analytically continued unitarity equations. The results are used to obtain in a consistent manner the discontinuity relations for the three coupled two-channel processes across the generated complex unitarity cut corresponding to the intermediate state which consists of one resonant isobar and one stable particle. (M.J.T.)

7838 $\Sigma-\Lambda$ MASS DIFFERENCE. Arnowitt, R. (Northeastern Univ., Boston). Nuovo Cimento (10), 40A: 985-9(Dec. 1, 1965).

A semiquantitative explanation of the $\Sigma-\Lambda$ mass difference is suggested, based on SU(3) invariance, with a Gell-Mann-Okubo type symmetry-breaking perturbation, plus certain quark-type equal-time commutation relations. (M.J.T.)

7839 RELATIVISTIC CORRECTIONS IN ELASTIC e-D SCATTERING. Adler, R. J. (Univ. of Washington, Seattle); Erickson, E. F. Nuovo Cimento (10), 40B: 236-42(Nov. 11, 1965).

A simple nonrelativistic wave-function model of the

deuteron is compared to what is believed to be its completely relativistic counterpart, following Cutkosky and Jones. The result is an ansatz which allows a plausible modification of more sophisticated wave-function models to a manifestly covariant form to be made. This ansatz is used in reanalyzing low momentum transfer elastic e-d scattering to yield the neutron charge-form factor. It is concluded that the surprisingly rapid curvature of this form factor at low momentum transfer as previously noted remains and is even somewhat increased if the ansatz is used. (auth)

7840 APPLICATION OF THE DASHEN-FRAUTSCHI METHOD TO THE CALCULATION OF THE DIFFERENCE BETWEEN THE nn AND np SINGLET SCATTERING LENGTHS. **Goldberg, H. (Faculte des Sciences, Orsay, France). Nuovo Cimento (10), 40B: 243-66(Nov. 11, 1965).**

The difference between the $^1S_0$ np and nn scattering lengths is calculated by a method due to Dashen and Frautschi. In the calculation the driving term used is the change in the one-pion exchange contribution between the two channels due to differences in the charged and neutral pion masses which are exchanged, in the charged and neutral πNN coupling constants, and in the external proton and neutron masses. The split in the coupling constants is also estimated with the same formalism and constitutes an independent result. The over-all result obtained is $a_{nn} - a_{np} = -(3.8 \pm 3.4)$ fermi, if the elementary-particle physics definition of scattering length is used. This is in qualitative agreement with recent experimental findings. (auth)

7841 ON THE DETERMINATION OF THE PROTON-PROTON $^1S_0$ SHAPE PARAMETER. **Slobodrian, R. J. (Univ. of California, Berkeley). Nuovo Cimento (10), 40B: 443-5(Dec. 11, 1965).**

It is shown that the $^1S_0$ shape parameter for proton-proton scattering cannot be determined with certainty on the basis of shape-dependent fits to the five accurately-known experimental phase shifts (at 0.38 to 3.04 Mev lab), with and without the vacuum polarization correction. The effects of fits at only four or three points are also considered. Results of a least squares fit to the data are summarized. It is concluded that existing data do not confirm as yet the validity of the vacuum polarization correction. (M.J.T.)

7842 THE ANNIHILATION OF POSITRONIUM FROM ^1P STATES. **Longe, P. (Univ., Liege). Phys. Lett., 19: 381-2(Nov. 15, 1965).**

For the annihilation probability of positronium, a wave function is used which is exact even in the close vicinity of the center of mass. The wave function is obtained by solving the Bethe-Salpeter equation taking into account the Coulomb and magnetic interactions with their delay effects, and the interaction due to the virtual annihilation. The real annihilation probability is calculated by the application of the S matrix to the wave function. The results of the calculations show that no relativistic contribution occurs and that the Pauli wave function is sufficient. It is concluded that the relativistic contribution appears in two ways, in the wave function and in the annihilation process. (J.F.P.)

7843 PION-NUCLEON SCATTERING AND RESONANT STATES NEAR 900 Mev. **Brandsen, B. H. (Univ. of Durham, Eng.); O'Donnell, P. J.; Moorhouse, R. G. Phys. Lett., 19: 420-1(Nov. 15, 1965).**

The phase shift analysis of meson (π)-nucleon scattering is extended to the 700 to 1100-Mev energy range. The results presented were obtained by treating the 300 to 700 Mev range, previously reported, and the 700 to 1100-Mev range separately. The data analyzed consist of differential cross sections and polarizations previously measured by other investigators. The dominant amplitudes in the $I = \frac{1}{2}$ channel are plotted in the Armand diagram. The most interesting feature is that the peak in the meson (π^-) cross section near 900 Mev has complex origin. The $I = \frac{1}{2}$ and $I = \frac{3}{2}$ phase shifts and absorption parameters are shown as a function of energy. (J.F.P.)

7844 IS THERE AN 11 Gev STRUCTURE IN THE TOTAL π^+-p CROSS SECTIONS? **Lautrup, B. (Nordisk Institut for Teortisk Atomfysik, Copenhagen); Nielsen, P. Moeller; Olesen, P. Phys. Lett., 19: 422(Nov. 15, 1965).**

In a comparison of the meson (π)-nucleon forward dispersion relations with experiments in the 10 Bev region, it was found that experimentally there is a dip in the real part at 12 Bev. The possibility that this could imply a bump in the total cross section somewhere below 12 Bev is explored. The cross sections are modified, and a bump is found having a certain height, which is of the Breit-Wigner type. A modification of the total cross sections is sought such that the tests given are all trivially satisfied. Two very different modifications are found which satisfy the tests. The first of these is a very broad bump with parameter values given. The second is rather narrow and lies between 10 and 12 Bev. The parameter values for these modifications are also given. (J.F.P.)

7845 $\tilde{U}(12)$ ABSORPTION MODEL FOR $P\bar{P} \rightarrow \Lambda\bar{\Lambda}$. **Watson, H. D. D.; Migneron, J. H. R. (Imperial Coll. of Science and Tech., London). Phys. Lett., 19: 424-6 (Nov. 15, 1965).**

Brief details of a calculation of $p\bar{p} \rightarrow \Lambda\bar{\Lambda}$ at 3.7 Bev/c, in which the $\tilde{U}(12)$ symmetry scheme is used to find peripheral amplitudes on which the requirements of unitarity are then approximately enforced by the inclusion of absorptive effects in the initial and final states, are presented. The four momentum transfer squared for this reaction, with results obtained for different choices of the masses against the experimental histogram, and the πNN coupling constant derived from the model are shown. It is found that the model gives an adequate description of the angular distribution, the magnitude of which is quite well predicted in terms of the πNN coupling constant. (J.F.P.)

7846 SEARCH FOR X^0 AND φ PRODUCED IN π^+p INTERACTIONS. **Trilling, G. H.; Brown, J. L.; Goldhaber, G.; Goldhaber, S.; Kadyk, J. A.; Scanio, J. (Univ. of California, Berkeley). Phys. Lett., 19: 427-30(Nov. 15, 1965). (UCRL-16294).**

The production of mesons (φ) (1019) Mev and mesons (X^0) (959 Mev) was sought in a hydrogen bubble chamber exposure to a 3.65-Bev/c meson (π^+) beam. The experimental results are shown and discussed. A scatter plot of the $p\pi^+$ mass versus $\pi^+\pi^-\eta$ mass for all events for which the $\pi^+\pi^-\eta$ mass lies between 830 and 1030 Mev, a triangle plot of $p\pi^+$ mass versus $K\bar{K}$ mass with both projections shown, and a scatter plot of $p\pi^+$ mass versus $K\bar{K}$ mass for all events for which the $K\bar{K}$ mass is less than 1050 Mev are given. It was found that the meson (X^0) is produced with a cross section of about 50μb and, within the statistics exclusively via $\pi + p \rightarrow N^*(1238) + X^0$. In the reactions $\pi^+ + p \rightarrow \pi^+ + p + K + \bar{K}$ an enhancement in the $K\bar{K}$ invariant mass in the 1,000 to 1,050 Mev region is observed, but the data do not agree with the interpretation that these events are associated with the meson (φ), as the observed width is far too large. In fact it is concluded that the data contain no evidence for meson (φ) production, and an upper limit is set for the total cross section for this reaction. (J.F.P.)

7847 BOSON SPECTRUM FROM 1.1 TO 1.6 Gev AND PROPERTIES OF A_2^- MESON OBSERVED BY MISSING-MASS SPECTROMETER. **Lefebvres, F.; Levrat, B.; Blieden, H. R.; (and others). Phys. Lett., 19: 434-7(Nov. 15, 1965).**

The meson (A_2^-) was previously observed as a prominent feature of the missing-mass spectrum in the reaction $\pi^- + p \rightarrow p + X^-$, at 5.6 and 6 Bev/c. With a signal-to-background ratio of 0.5 ± 0.05, 1425 events were found above phase-space, inside the peak, whose best-fit values for mass and width are $M = 1.290 \pm 5$ Mev, and $\Gamma = 99 \pm 15$ Mev. In addition to the usually reported decay mode $A_2^- \rightarrow \rho^0\pi^-$, the mode, $A_2^- \rightarrow 1$ charged particle + neutrals, which implies $A_2^- \rightarrow \rho^-\pi^0$ was found. The differential and total cross section values for meson (A_2) production in the two-body process are obtained. (J.F.P.)

7848 EVIDENCE FOR A SINGLY CHARGED BOSON OF MASS 962 Mev AND NARROW WIDTH. **Kienzle, W.; Maglic, B. C.; Levrat, B.; Lefebvres, F.; Freytag, D.; Blieden, H. R. (CERN, Geneva). Phys. Lett., 19: 438-41 (Nov. 15, 1965).**

An analysis is presented of the missing-mass spectrum of the proton measured in the reaction $\pi^- + p \rightarrow p + X^-$ between $M_X = 0.9$ and 1.0 Bev at incident meson (π) momenta of 3.0 ± 0.1, 3.5 ± 0.1, 4.5 ± 0.045, and 5.0 ± 0.05 Bev/c. A narrow peak at $M_X = 962 \pm 5$ Mev mass is observed with a statistical significance of 4.6 standard deviations above background. The measured width $\Gamma \approx 15 \pm 2$ Mev is comparable with the calculated experimental resolution, the physical width being $\Gamma \leq 5$ Mev. The total production cross section is $15 \pm 5\mu b$. The isospin of the peak is either T = 1 or 2, as seen from the production reaction. The missing-mass spectrum and a statistical analysis of the 962-Mev peak are shown. (J.F.P.)

7849 K^- p ELASTIC SCATTERING AT 3 Gev/c. Focacci, M. N. (Univ., Bologna); Focardi, S.; Giacomelli, G.; Serra, P.; Zerbetto, M. P.; Monari, L. Phys. Lett., 19: 441-4(Nov. 15, 1965).

The experimental results on the K^-p elastic scattering at 2.985 ± 0.015 Bev/c are presented. The film of 25,000 pictures was scanned for two-prong events. A final selection of 1638 elastic events gives a chi-squared distribution appropriate to a four constraint fit. The differential elastic cross section as a function of the four-momentum transfer squared is presented and plotted. The integrated elastic cross section was found to be 4.95 ± 0.22 mb. Within the statistics, the data indicate that the K^-p scattering at backward angles is similar to π^-p scattering. (J.F.P.)

7850 OBSERVATION OF ρ^- MESON WITH A MISSING-MASS SPECTROMETER OPERATING IN REGION OF "JACOBIAN PEAKS." Blieden, H. R.; Freytag, D.; Geibel, J.; Hassan, A. R. F.; Kienzle, W.; Lefebvres, F.; Levrat, B.; Maglic, B. C.; Seguinot, J.; Smith, A. J. (CERN, Geneva). Phys. Lett. 19: 444-8(Nov. 15, 1965).

The mass spectrum of charged bosons in the mass region 650 to 850 Mev is presented. This spectrum was obtained from a missing-mass spectrometer operating on the principle of "Jacobian peaks in angular distribution." The unstable bosons, x^-, are produced in the reaction $\pi^- + p \rightarrow p + X^-$ at incident momenta of 3.0 ± 0.1, 3.5 ± 1, 4.5 ± 0.045, and 5.05 ± 0.05 Bev/c. The experimental arrangement is shown and described. The experimental data are given including the missing-mass distributions. The best values for the mass and width of the meson (ρ^-) were found to be $M_\rho = 768 \pm 5$ Mev, and $\Gamma_\rho = 127 \pm 5$ Mev. Also an upper limit of 2.6% was found for the decay $\rho \rightarrow \pi^-\pi^-\pi^+\pi^0$. (J.F.P.)

7851 MASS OF N_{33} FROM N/D CALCULATION WITH $SU_6(W)$ VERTICES. Gatto, R.; Veneziano, G. (Univ., Florence). Phys. Lett., 19: 512-13(Dec. 1, 1965).

The possibility is considered that a correct inclusion of invariant vertices in a consistent dynamical approximation may produce sensible results. Specifically an N/D calculation of low-energy meson (π)-nucleon scattering with insertion of $SU_6(W)$ invariant vertices is performed. The imposition of unitarity is found to be a useful constraint: from the symmetry vertex requirement the correct value of the mass of N^* is computed. The discussion is limited to the resonant amplitude. It is remarked that an exact cancellation occurs, as a consequence of the $SU_6(W)$ requirement, of the lowest order S-wave terms (proportional to mf^2/μ^2 and to f^2/μ) and it may be useful in the interpretation of the smallness of these waves. (J.F.P.)

7852 AXIAL VECTOR MESON AND THE HYPERFINE STRUCTURE OF HYDROGEN. Fenster, S.; Koeberle, R.; Nambu, Y. (Univ. of Chicago). Phys. Lett., 19: 513-15(Dec. 1, 1965).

The effect of an axial vector meson ($J^{PC} = 1^{++}$) which can be exchanged between the proton and the electron, and thereby contribute electromagnetic Gamow-Teller interaction, is considered. The strength of this interaction may be related to that of the known meson (π) exchange term through a formula derived previously using Goldberger-Treiman type arguments. It is shown that the effect of the electromagnetic Gamow-Teller interaction, though still not unambiguously calculable, has the same order of magnitude as the discrepancy, and may be responsible for the bulk of it. (J.F.P.)

7853 AXIAL MESON EXCHANGE AND THE RELATION OF HYDROGEN HYPERFINE SPLITTING TO ELECTRON SCATTERING. Drell, S. D.; Sullivan, J. D. (Stanford Univ., Calif.). Phys. Lett., 19: 516-18(Dec. 1, 1965).

It is shown that the suggestion by Fenster (Physics Letters 19, 513 (1965)) that the exchange of an axial vector meson ($J^{PC} = 1^{++}$) might remove much of the apparent discrepancy between theory and experiment for the ground state hyperfine splitting of hydrogen is difficult to reconcile with existing data on the ratio of positron-proton to electron-proton elastic scattering. (J.F.P.)

7854 MASS SPLITTING AND UNITARITY. Fraser, G. (Imperial Coll. of Science and Tech., London). Phys. Lett., 19: 521-3(Dec. 1, 1965).

The ratios of amplitudes for various proton-antiproton annihilation modes at rest have been calculated on the basis of a broken inhomogeneous $\overline{U}(12)$ symmetry scheme, (Hussain and Rotelli, Physics Letters 16, 183 (1965)), with results in serious disagreement with experiment. A method is presented for estimating the effects of mass splitting within the baryon octet, using the inverse reaction matrix formalism of Matthews and Salam (Nuovo Cimento 13, 381 (1959)). This mass splitting was neglected in the previous calculations, and although the mass splitting between the observed particles is small, the splitting within the baryon octet is large. For stopped $p\bar{p}$ reactions, this suppresses intermediate states composed of behavior baryon-antibaryon pairs. This has an effect on the observed process because of unitarity. (J.F.P.)

7855 VECTOR MESON DECAYS AND THE ALGEBRA OF CURRENTS. Mathur, V. S.; Pandit, L. K. (Univ. of Rochester, N. Y.). Phys. Lett., 19: 523-5(Dec. 1, 1965).

The decay of vector mesons is studied, using the notation of Pandit and Schechter (Physics Letters 19, 59 (1965)). The coupling constant $G^2_{\omega p\pi}/4\pi$ is found to be $14.8/M^2$, and the width for the $\omega \rightarrow 3\pi$ decay is 10.8 Mev. The coupling constant for the K^* decays is also determined. These are $G^2_{K^*K\pi}/4\pi \approx 5/M^2_{K^*}$ and $G^2_{pK^*K}/4\pi \approx 3/M^2_{K^*}$. (J.F.P.)

7856 COHERENT 6 Gev/cπ^+ INTERACTIONS ON DEUTERON. Vegni, G. (CERN, Geneva); Winzeler, H.; Zaniol, P.; Fleury, P.; De Rosny, G. Phys. Lett., 19: 526-8(Dec. 1, 1965).

The extension to deuterium of the so-called coherent interactions previously observed on heavier nuclei is sought, and the results are compared with those from a sample of elastic scattering events found in the same experiment. A deuterium-filled bubble chamber was exposed to a 6 Bev/c meson (π^+) beam. In a total sample of 794 four prong events fitting the reaction $\pi^+ + d \rightarrow pn\pi^+\pi^+\pi^-$, 251 events also fit the reaction $\pi^+d \rightarrow d\pi^+\pi^+\pi^-$. In the distribution of the pn angle projected on the plane of the films, these 251 events contribute to a very narrow peak. Other distributions are also shown. It is concluded that most of the events are due to a single mechanism, mainly characterized by a transverse momentum distribution connected with the radius of the deuterium and by the production of a meson (ρ). But, it is pointed out that in a certain fraction of the events (<15%), the π^+ not belonging to the ρ can come from an excited state of deuterium of effective mass of about 2.15 Bev/c^2. (J.F.P.)

7857 SEARCH FOR INTERMEDIATE VECTOR BOSON PRODUCTION IN NUCLEON-NUCLEON COLLISIONS. Lamb, R. C. (Argonne National Lab., Ill.); Lundy, R. A.; Novey, T. B.; Yovanovitch, D. D.; Good, M. L.; Hartung, R.; Peters, M. W.; Subramanian, A. Phys. Rev. Lett., 15: 800-2(Nov. 15, 1965).

An experiment was conducted to detect W production in nucleon-nucleon interactions. This experiment gives a sensitivity to W masses in the range of 2 to 3 Bev. No meson (μ) signal was found in excess of that due to meson (π) and meson (K) decay. The experimental apparatus is shown. A proton beam of 12.5 Bev/c was incident on a uranium target. The beam spot was continuously observed by a closed circuit TV-scintillator system. The absorption curve for 4-Bev/c negative particles from the target is

shown. Experimental intensities measured by varying the thickness of the absorber are given, and the fit to the data is shown. A curve of the meson (μ) spectrum at 1840 g/cm^2 absorber, and a curve for the calculated meson (μ) spectrum for meson (π) decay are given. Then the momentum spectrum of the mesons (π) is shown with the π + K decay background subtracted out. The upper limit of the product of W-production cross section times the branching ratio for W decay into a meson (μ) was found to be $\leq 4\ (10)^{-34}$ (Bev/c)$^{-1}$ nucleon^{-1}. (J.F.P.)

7858 EVIDENCE FOR THE EXISTENCE OF AN I = 0 MESON STATE OF 1610-Mev MASS. Kernan, W. J.; Lyon, D. E.; Crawley, H. B. (Iowa State Univ., Ames). Phys. Rev. Lett., 15: 803-5(Nov. 15, 1965). (IS-1224).

An I = 0 meson state at 1610 Mev was observed in an examination of 20,000 pictures taken with the hydrogen bubble chamber exposed to a 2.7 Bev/c beam of antiprotons. Approximately 3,000 four-prong events with vertices restricted to a limited fiducial volume of the chamber were measured. In these 3,000 events the reaction $\bar{p} + p \rightarrow \pi^+ + \pi^+ + \pi^- + \pi^- + \pi^0$ were investigated. Analysis of four-meson (π) effective mass spectra for the neutral combination ($\pi^+\pi^+\pi^-\pi^-$) deviates significantly at a mass value of about 1600 Mev and width of 150 Mev. Four-body effective mass plots are given, and center-of mass angular distribution of mesons (π^0) are shown. The fits are obtained by minimizing χ^2 for an isotropic fit without requiring the total number of events and the number of events represented by the fit to be identical. The center-of-mass angular distribution of mesons (π^0) for ambiguous events is also shown. (J.F.P.)

7859 LIMIT ON d/f RATIO FROM Ξ^- ASSOCIATED PRODUCTION. Ebel, M. E.; James, P. B. (Univ. of Wisconsin, Madison). Phys. Rev. Lett., 15: 805-7 (Nov. 15, 1965). (COO-30-105).

A simple model is used to compute the differential cross section for Ξ^- associated production in K^--p interactions. It is assumed that this process is dominated by single exchanges of Λ^0, Σ^0, and Y_1^{*0} in the u channel and by the Λ^0 and Σ^0 poles in the s channel. The differential cross section for Ξ^- production is plotted as a function of the cosine of the center-of-mass scattering angle. It is emphasized that the limit obtained does not depend upon the initial and final state absorptive corrections, although quantitative conclusions may not be divorced from these corrections. The assumption that single-particle exchanges dominate in associated production leads to this limit. (J.F.P.)

7860 SINGLE REGGE POLE ANALYSIS OF π^- + p $\rightarrow \eta^0$ + n. Phillips, Roger J. N.; Rarita, William (Univ. of California, Berkeley). Phys. Rev. Lett., 15: 807-10(Nov. 15, 1965). (UCRL-16442).

The Regge pole analysis of the case, π^- + p $\rightarrow \eta^0$ + n (Phys. Letters 18: 200(1965)), at small momentum transfers, is presented. Here only the Regge pole (R) (associated with the A_2 meson) is known to have the correct cross channel quantum numbers. It is shown that these data are consistent with a single Regge pole whose trajectory is consistent with the meson (A_2) mass. It is desirable to reanalyze the KN and $\bar{K}$N data simultaneously with the new information about the π^- + p $\rightarrow \eta^0$ + n without the use of SU(3) symmetry (which is not exact), to show that the same R trajectory is consistent with both sets of data. Thereby a precise test of the accuracy of SU(3) symmetry is also achieved. At high energies the $\eta - \pi$ mass-difference effects are negligible compared with experimental errors, and elastic kinematics is used. (J.F.P.)

7861 SEARCH FOR INTERMEDIATE BOSONS IN PROTON-NUCLEON COLLISIONS. Burns, R.; Danby, G.; Hyman, E.; Lederman, L. M.; Lee, W.; Rettberg, J.; Sunderland, J. (Columbia Univ., New York. Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 15: 830-4(Nov. 22, 1965).

A measurement of the yield of high-energy mesons (μ) emitted at large angles to a beam of 20- and 30-Bev/c protons was carried out. The objective was to set an upper limit to the production and decay probability of massive unstable states decaying into mesons (μ). The intermediate boson W was used as the massive unstable state investigated; this decays into mesons (μ) and neutrinos. The experimental arrangement is illustrated and described. A block of 90% tungsten absorbed the proton beam and its secondary particles. Curves for meson (μ) counts at various energies are given. There are also curves showing the subtracted results and calculation of the meson (μ) flux from the W's. The cross sections of the W's per nucleon times the branching ratio for the decay of the W's to mesons (μ) are given for various W masses in Bev and proton momenta. It is emphasized that the experiment integrates over all possible final states. In order to get some estimate of the sensitivity to mass, the relative phase space is given for typical final states. (J.F.P.)

7862 SEARCH FOR RHO-MESON DECAY INTO MUONS. Boyarski, A. (Massachusetts Inst. of Tech., Cambridge); Glass, G.; Chase, R. C.; Gettner, M. Phys. Rev. Lett., 15: 835-8(Nov. 22, 1965).

A search is reported for the meson (μ)-pair decay mode of the meson (ρ). Evidence for this decay mode was sought in the effective-mass distribution of meson (μ) pairs produced by a 4.85-Bev bremsstrahlung beam incident on a carbon target. In the mass region studied, meson (μ)-pair production is dominated by the Bethe-Heitler process. Contributions from ρ decays, if present in sufficient quantity, would appear as a peak, above the Bethe-Heitler yield, in the effective-mass distribution of the meson (μ) pairs. The observed distribution does not show a significant difference from one calculated from the Bethe-Heitler pair-production process. Thus this experiment together with a knowledge of the ρ-photoproduction cross section determines an upper limit for the branching ratio R. Using the measured ρ-production cross section for carbon, an upper limit of $R < 2\ (10)^{-4}$ is obtained. The apparatus and calculations are described. (J.F.P.)

7863 π^- + p ELASTIC SCATTERING FROM 2.5 TO 6 Gev/c. Coffin, C. T.; Dikmen, N.; Ettlinger, L.; Meyer, D.; Saulys, A.; Terwilliger, K.; Williams, D. (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett., 15: 838-41(Nov. 22, 1965).

The differential elastic-scattering cross section was measured for π^- + p collisions at four incident meson (π) momenta: 2.5, 3.0, 4.0, and 6.0 Bev/c. The emphasis is placed on scattering at relatively large momentum transfers, in particular, on the structure in the differential cross section near the backward direction and in the region of the secondary maximum at $-t = 1.2$, which was previously observed at lower energies. The experimental apparatus is illustrated and described, and the data analysis is discussed. The π^- + p differential cross sections obtained are given, and the momentum dependence of π^- + p elastic differential cross section is shown. (J.F.P.)

7864 APPLICATION OF CURRENT COMMUTATION RULES TO NONLEPTONIC DECAY OF HYPERONS. Sugawara, Hirotaka (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 15: 870-3(Nov. 29, 1965).

The commutation rules, together with other assumptions, are applied to nonleptonic processes, since the current commutation relations derived from the quark model were successfully applied to get the axial-vector renormalization constant. It is noted that the formulation gives a method for calculating the magnitude of the nonleptonic decay amplitudes. (J.F.P.)

7865 PROTON COMPTON SCATTERING MEASUREMENT FROM 450 TO 1350 Mev NEAR 90 deg IN THE CENTER-OF-MASS SYSTEM. Rust, D. R.; Eisenhandler, E.; Mostek, P. J.; Silverman, A.; Sinclair, C. K.; Talman, R. M. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 15: 938-41(Dec. 13, 1965).

An experiment was performed to measure the 90° cms differential cross section for γp scattering (proton Compton scattering), for incident laboratory photon energies between 450 and 1350 Mev. Effects of the first, second, and third πp resonances, and possibly a higher one are seen. The analysis is simplified by the smallness of the elastic cross section in comparison with the various inelastic meson (π)-photoproduction cross sections. The effect of this is that the reactive effect of the elastic-scattering process on itself, through the unitarity condition, is negligible. At the same time, the reactive effects of the inelastic channels are not only important but are, in principle, known in terms of measured processes. This situation prevails throughout the region of the data. The experimental arrangement is shown, and the analysis of the data is described. The measured differential cross sections are shown together with previous experimental results. A model is presented describing the data. (J.F.P.)

7866 CONSEQUENCES OF CURRENT COMMUTATION RELATIONS IN THE NONLEPTONIC HYPERON DECAYS. Suzuki, Mahiko (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 15: 986-9(Dec. 20, 1965). (CALT-68-54).

The consequences of the current commutation relations and of the partially conserved axial-vector current hypothesis in the nonleptonic hyperon decays are discussed. The basic idea consists in relating the matrix elements of the nonleptonic hyperon decays to those between octet baryon states of bilinear products of vector and axial-vector unitary spin currents by means of equal-time commutation relations of current components. The pv amplitudes are given, and the predicted relations are satisfied very well. One of the most important results is that the $\Delta I = \frac{1}{2}$ rule is derived for the Λ and Ξ decays without octet dominance and that the sum rule, experimentally equivalent to the $I = \frac{1}{2}$ rule, is derived for the Σ decay. But there is a difficulty in the pc amplitudes. These are forbidden by SU(3) and the partially conserved axial-vector current hypothesis according to the present discussion. (J.F.P.)

7867 EXPERIMENTAL INFORMATION ON NEGATIVE KAONS. Nikolic, M. M. (CERN, Geneva). Progr. Elem. Particle Cosmic Ray Phys., 8: 123-238(1965).

Experimental data of the properties, production and interactions of K^--mesons are presented. Some experiments primarily designed to investigate the properties and interactions of secondary particles arising from K^- interactions are briefly considered, and some problems of atomic and nuclear physics that may be studied by means of K^- mesons are mentioned. (L.B.S.)

7868 RESONANCES. Tenner, A. G.; Wolters, G. F. (Univ., Amsterdam). Progr. Elem. Particle Cosmic Ray Phys., 8: 239-370(1965).

Experimental studies on the production and properties of resonances are reviewed. The two different conditions under which resonances are observed by analyzing the products of the final states in the scattering of two strongly interacting particles are treated separately. The first deals with elastic resonance excitation, which leads to the production of strange isobars and nucleon isobars. Experimental results of inelastic resonance excitation experiments and some of the theoretical explanations are treated, which include non-strange mesonic resonances, strange mesonic resonances, and strange baryonic resonances. (L.B.S.)

7869 CLASSIFICATION OF ELEMENTARY PARTICLES AND QUARKS "PRESENTED FOR PEDESTRIANS." Zel'dovich, Ya. B. Usp. Fiz. Nauk, 86: 303-14(June 1965). (In Russian)

The importance of recent discoveries of elementary particles matches that of the periodic table; however, their complex classification schemes and their frightening nomenclature renders the problem unintelligible for the nonspecialists. This state of affairs necessitated the development of a more "pedestrian" approach. It is assumed that all particles are composed of 3 types of the most fundamental particles, called quarks. Thus, all baryons consist of 3 (identical or different) quarks; each meson consists of a quark and an antiquark. The classification scheme applies to strongly interacting particles, called hadrons and does not include electrons, muons, neutrinos and photons. The concepts of particle spin and of particle and antiparticle, and the division into particles and antiparticles are considered. Particles that may be decomposed into a proton and a certain number of electrons, neutrinos and mesons are designated as baryons. In strong interactions, such as collisions, the strangeness of the particle is conserved. Resonances are also considered as an elementary particle; a pion and a proton may form a new particle, designated as Δ, which may subsequently decompose, emitting a pion in another direction. The principles of the quark theory are outlined. The theory gives simple and logical questions arising from the octet and decuplet schemes; the SU(3) and SU(6) systems are also discussed. The problem of the actual existence of the quarks, –or baryonets,–is also brought up, pointing to experimental work aimed at the finding of particles with a fractional charge in cosmic ray studies and in accelerator experiments, as required by the theory. (TTT)

7870 ON THE POSSIBILITY OF USING NUCLEAR REACTORS IN COSMIC SPACE FOR DIRECT MEASUREMENTS OF nn SCATTERING CROSS SECTIONS. Bondarenko, I. I.; Kovalev, V. P.; Zolotukhin, V. G. Yadern. Fiz., 2: 839-42(Nov. 1965). (In Russian).

An analysis of an experiment for the direct measurement of the n-n scattering cross section in the singlet state is performed. For the measurement of the cross section, a pulsed nuclear reactor having a negative temperature coefficient and located in cosmic space at an altitude of 400 to 500 km is proposed. It is shown that the scattering length can be determined with an error of ±10%. (auth)

7871 DETERMINATION OF RELATIVE PROBABILITIES OF $K_2^0 \to 3\pi$ DECAYS. Anikina, M.; Vardenga, G.; Zhuravleva, M.; Kotlyarevskii, T.; Nyagu, D.; Okonov, E.; Takhtamyshev, T.; Wu, Tsung-fan; Chkhaidze, L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 2: 853-8(Nov. 1965). (In Russian).

The following estimates were obtained for the ratios of the decay probabilities of $K_2^0 \to 3\pi^0$, and $K_2^0 \to \pi^+\pi^-\pi^0$ to the probability of the decay of K_2^0 into charged particles: 0.29 ± 0.08; and 0.18 ± 0.06 respectively. The $K_2^0 \to 3\pi^0$ decay was detected by observing the Dalitz pair from the π^0 and $K_2^0 \to \pi^+\pi^-\pi^0$ and by four-prong events with $\pi^+\pi^-$ mesons and a Dalitz pair. The ratio $\Gamma_2(3\pi)/\Gamma_+(3\pi) = 1.19 \pm 0.23$ is in agreement with the selection rule $|\Delta I| = \frac{1}{2}$. (auth)

7872 ELECTROMAGNETIC STRUCTURE OF PROTONS AND HYPERFINE SPLITTING IN HYDROGEN. Tukhtyaev, Yu. N.; Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 2: 882-5 (Nov. 1965). (In Russian).

The influence of the proton electromagnetic form factors upon the hyperfine structure of the ground state of hydrogen is investigated by means of the quasipotential equation for the two-fermion system. The correction to the Fermi formula of the order of $\alpha(m/M)$ is calculated. The theoretical and experimental results are compared. (auth)

7873 SCATTERING OF π^- MESONS WITH MOMENTUM OF 4 Gev/c BY ELECTRONS. Grishin, V. G.; Kistinev, E. P.; Mu, Chun (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 2: 886-91(Nov. 1965). (In Russian).

The scattering of mesons(π^-) by electrons at 4 Bev/c was investigated. The experimental differential cross section is in agreement with theoretical calculations for meson(π^-) scattering by the point electron. (D.C.W.)

7874 MEASUREMENT OF THE POLARIZATION IN pp SCATTERING AT 667 Mev. Azhgirei, L. S.; Kumekin, Yu. P.; Meshcheryakov, M. G.; Nurushev, S. B.; Solovyanov, V. L.; Stoletov, G. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 2: 892-6(Nov. 1965). (In Russian).

The polarization in p-p scattering was studied in a

double scattering experiment. For large angles, renormalization of the data at 635 Mev was performed. The polarization was observed to increase with energy from 602 to 656 Mev. The angular distribution of the polarization of 667 Mev shows a considerable contribution from the triplet states with orbital momenta up to l = 5. A set of phase shifts that describe the polarization and other experimental data in the region near 660 Mev is included. (D.C.W.)

7875 VECTOR MESON DECAYS IN THE SU(6) SYMMETRY. Rekalo, M. P. Yadern. Fiz., 2: 928-30(Nov. 1965). (In Russian).

The relations between the three meson interaction constants are obtained in SU(6) symmetry. The suppression of the meson(φ) decays $\varphi \to \rho + \pi$; $\varphi \to 3\pi$; and $\varphi \to \pi^0 + \gamma$ is explained. (D.C.W.)

7876 ON THE REAL PART OF THE ZERO-SPIN AMPLITUDE WITH T = 0 AND SPIN-DEPENDENT NUCLEON–NUCLEON SCATTERING AMPLITUDES AT HIGH ENERGY. Kanavetz, V. P. (Inst. of Experimental and Theoretical Physics, State Atomic Energy Commission, USSR). Yadern. Fiz., 2: 931-7(Nov. 1965). (In Russian).

It is shown that the real part of the zero-spin amplitude Re $\alpha^{(0)}$ or the spin-dependent amplitudes contribute to the isotopic amplitude $A^{(0)}$ for energies up to 2 to 3 Bev. At E_{kin} = 2 Bev, $|A^{(0)}|^2/[\text{Im } \alpha^{(0)}]^2 \geq 1.14 \pm 0.07$. The value Re $\alpha^{(0)}$ at 2.85 Bev was obtained (under the assumption of the small contribution of the spin-dependent amplitudes) from the neutron-proton charge-exchange experimental data. This value is (0.35 ± 0.12) Im $\alpha^{(0)}$ or (-0.8 ± 0.12) Im $\alpha^{(0)}$. The arguments which make the second solution more plausible are given. A discussion of the value of Re $\alpha^{(0)}$ and the spin-dependent amplitudes obtained from the n-p elastic scattering experiment is included. (auth)

7877 PRODUCTION OF $W^{\pm}$ MESONS IN THE ANNIHILATION OF POLARIZED PROTONS AND ANTIPROTONS. Doan, Nhuong; Sadykhov, F. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 2: 940-4(Nov. 1965). (In Russian).

The production of intermediate mesons in the annihilation of an arbitrarily polarized proton and antiproton is studied in the one-photon approximation. The complex proton form factors are considered on the basis of the cross section. (D.C.W.)

7878 INVESTIGATION OF EFFECTIVE MASS PRODUCED IN DIFFRACTION DISSOCIATION PROCESSES. Bozoki, G.; Gombosi, E.; Nagy, E. (Central Inst. of Physical Studies, Budapest). Yadern. Fiz., 2: 945-9 (Nov. 1965). (In Russian).

An angular method is proposed for the determination of the effective mass of the outgoing particles in diffraction dissociation events (DD). In an analysis of events of pion diffraction dissociation on emulsion nuclei at 17.2 Bev/c by this method it was observed that the mean value of the effective mass coincides with the mass of the $A_1(\rho\pi)$ system. The lower limit of the mean free path of DD processes with production of $A_1(\rho\pi)$ was estimated to be 45 ± 5 m. (auth)

7879 THE PROTON-ANTIPROTON ANNIHILATION AT REST AS PREDICTED BY THE SU_6-COVARIANT S-MATRIX FORMALISM AND BY W-SPIN ANALYSIS. Schuelke, Lothar (Univ., Heidelberg). Z. Phys., 189: 207-11(1966).

The proton-antiproton annihilation at rest into two mesons is calculated by two methods: (i) on the basis of the SU_6-covariant S-matrix formalism recently proposed by Rothleitner and Stech, and (ii) by assuming the additional invariance under the group $(SU_6)_W$ proposed by Lipkin and Meshkov. In the first case the calculations give only few relations between transition amplitudes, whereas the larger symmetry group $(SU_6)_W$ actually determines all amplitudes up to a common factor. While agreement with experiment seems to be poor in some cases for the $(SU_6)_W$, so far there are no experimental data available to test the relations of case (i). (auth)

7880 DYNAMICAL MODEL OF THE Σ [Thesis]. Kayser, Boris Jules. Pasadena, Calif., California Inst. of Tech., 1964. 152p.

In the spirit of the bootstrap hypothesis, a dynamical model is developed for the Σ hyperon, taking into account the $\pi\Lambda$ and $\pi\Sigma$ channels. Born amplitudes for the exchange of Λ, Σ, Y_1^* (1385 Mev), Y_0^* (1405 Mev), and ρ form the inputs to dynamical calculations, which utilize an extension of the matrix ND^{-1} method. The properties of all particles other than the Σ are taken from experiment, or, where they are experimentally uncertain, estimated on the basis of current theoretical ideas and then varied in the calculations. The cutoff that governs the damping of the input amplitudes at high energies is also varied. It is found that quite a few combinations of the experimental unknowns and the cutoff do lead to a self-consistent $\frac{1}{2}^+$, I = 1 $\pi\Lambda$-$\pi\Sigma$ bound state, identified as the Σ, with reasonable values for the mass M_Σ and couplings $g^2_{\pi\Lambda\Sigma}/4\pi$ and $g^2_{\pi\Sigma\Sigma}/4\pi$. These results favor the conjecture that the Σ is a composite particle. (Dissertation Abstr.)

7881 WEAK INTERACTIONS OF ELEMENTARY PARTICLES. Okun, L. B. New York, Daniel Davey and Co., Inc., 1965. 181p. $12.75.

Translation by Z. Lerman of Slaboe Vzaimodeistvie Elementarnykh Chastits.

The main concepts and problems of the theory of weak interactions, and its computational apparatus are presented. The two central hypotheses are the existence of a universal weak interaction and the compound model of strongly interacting particles. These bring out the connections between various problems of the theories of weak and strong interactions. (J.F.P.)

7882 THE PHYSICS OF ELEMENTARY PARTICLES. Muirhead, H. New York, Pergamon Press, 1965. 751p. $20.00.

The physical principles that are used to describe the properties and behavior of the elementary particles are discussed. The topics included are the discovery and classification of elementary particles, intrinsic properties of particles, quantized field theory, quantum theory of noninteracting fields, symmetry properties of free fields, field interactions, S-matrix, invariance properties, dispersion relations, and electromagnetic, weak, and strong interactions. (C.E.S.)

7883 POLARIZATION PARAMETER IN PROTON-PROTON SCATTERING FROM 328 TO 736 Mev [Thesis]. Betz, Frederick William. Berkeley, Calif., Univ. of California, 1965. 91p.

The polarization parameter in elastic proton-proton scattering was measured at several energies and angles. The unpolarized external proton beam from the 184-inch synchrocyclotron was made incident upon a polarized target. The full energy of the beam was degraded by means of copper absorbers to obtain beams with laboratory kinetic energies of 328, 614, 679, and 736 Mev. The elastic proton-proton scatterings were kinematically separated from background events by detection of both protons in coincidence with the use of scintillation counters. Measurements were made in the center-of-mass angular region from 33 to 110 degrees (at smaller angles the slower proton lacked sufficient range to emerge from the target). The target was polarized by means of a technique called dynamic nuclear orientation. Its polarization was measured by monitoring the nuclear magnetic resonance signal of the free protons in the target. This signal was calibrated in terms of absolute magnitude of polarization by measurement of the temperature of the proton system and the frequency of its resonance when the polarization of the target was unenhanced. The experimental procedure was to count the number of elastic scatterings into a solid angle with the polarization of the target parallel to the normal to the scattering plane and then, under identical conditions, to count the elastic scatterings with the direc-

tion of the polarization of the target reversed. The measured values of the polarization parameter are presented as a function of angle for each incident proton energy. (Dissertation Abstr.)

7884 RADIATIVE CORRECTIONS TO ELECTRON-INDUCED PROCESSES [Thesis]. Kuo, Pao-kuang. Minneapolis, Univ. of Minnesota, 1964. 79p.

It is known that the cross section of an electron-induced process is approximated very closely by the Weizsacker-Williams method. A better approximation may be obtained by using Møller potential for the electron and assuming the the electromagnetic current of the strongly-interacting system has the same value as in the parallel photon-induced process. A cross section obtained by this method is called the "standard value" term. It is the small deviation from this standard value term that yields the sought information. For electron energy in the several hundred Mev to several Bev region the deviation is usually expected to be in the 5–10% region. Thus it is necessary to include the radiative corrections to the standard value term, which could be of the order of 5–15% as judged from calculations performed on electron-proton scattering experiments. In this work the radiative corrections to electron-induced processes are treated in general with a specific example of the process $e + p \rightarrow e' + n + \pi^+$. Methods for calculating radiative corrections to high energy processes in general have been developed by Yennie and Meister; some extension or modification of the existing methods is necessary. Results have shown that the radiative corrections are on the low side of the expectation, being about 5% for moderate energies, reaching 10% only for one of the calculated cases, where the electron has 25 Bev initial energy and loses 90% of its energy during the process. For energy loss less than 0.1 the radiative corrections are about 1% of the standard value term. (Dissertation Abstr.)

Field Theory, Scattering Theory, and Symmetries

See also Elementary Particles and Radiations

Refer also to abstract 8113.

7885 (IC/65/67) SU_3—COMPOSITE SYMMETRY AND WEAK INTERACTIONS. Cocho, G. (International Centre for Theoretical Physics, Trieste (Italy)). Oct. 1965. 42p. Dep. mn.

An SU_3 "composite" symmetry model is considered. A $U(9) \times U(9)$ group and a relativistic boosting are also discussed. Within such SU_3 composite model, assuming that in the non-leptonic decays the weak hamiltonian transforms as the central component of the $SU_3(\vec{S}, \vec{B})$ octet of the $(9, \bar{9})$ representation of $U(9) \otimes U(9) \supset SU_3(\vec{S}, B) \otimes \underline{SU_3}(\vec{T}, Y)$ the scalar-pseudoscalar mixing is fixed to be $\sqrt{2/3}\, S - \sqrt{1/3}\, P$. One obtains with essentially one parameter a reasonable fitting for both non-leptonic decays of hyperons and $K_1 \rightarrow \pi + \pi$ decay. If one assumes that in the leptonic decays such scalar-pseudoscalar mixing is reflected in the vector-axial vector ratio, it also follows that $|g_A/g_V| = 5/3\sqrt{2}$. (auth)

7886 (JINR-P-2311) OBOBSHCHENIE DVUKHMERNOI MODELI POLYA BORNA-INFELDA NA NESKOLKO VZAIMODEISTVUYUSHCHIKH POLEI I KVANTOVANIE ETOI SISTEMY. (A Generalization of Two-Dimensional Model of Born-Infeld Field to the Case of Several Interacting Fields and the Quantization of This System). Barbashov, B. M.; Chernikov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 18p. Dep. mn.

On the basis of the solution of the Cauchy problem for the scalar two-dimensional field model of Born-Infeld, a procedure of this field quantization is developed. Since in the classical solution of the Cauchy problem the time t and the x-coordinate are treated as components of a new field, then, as a result of a quantization of this field t and x turn out to be the operators besides the wave function of the field. The geometrical treatment of the model as an external surface is a three-dimensional pseudo-dimensional pseudoeuclidean space leads to its natural generalization to the case of several interacting fields. The generalized model is regarded as a two-dimensional extremal surface in the many-dimensional pseudoeuclidean space. (auth)

7887 (JINR-P-2392) KLASSIFIKATSIYA BOZONNYKH REZONANSOV V MODELI $\overline{W}_3$-SIMMETRII. (Classification of Boson Resonances in $\overline{W}_3$ Symmetry Model). Kvetsinski, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 6p. Dep. mn.

A classification of the known boson resonances in the $\overline{W}_3$ symmetry scheme is suggested. It is shown that in the case of $(1^+, 1^-)$ mesons the mass formulas of the broken $\overline{W}_3$ symmetry are fulfilled with an accuracy of some percent. The presence of additional 0^+ and 2^- mesons follows from the scheme. Approximate values of their masses are determined. (auth)

7888 (JINR-P-2418) ODNOMERNAYA ZADACHA RASSEYANIYA NA SISTEME DVUKH CHASTITS S DISKRETNYM SPEKTROM. (One-Dimensional Scattering Problem on a Two-Particle System with a Discrete Spectrum). Lupashina, I. S.; Sokolov, S. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 10p. Dep. mn.

A problem is considered of particle scattering on a system of two particles which cannot dissociate. The convergence is proved of an infinite system of integral-differential equations, for potentials for which the spacing between levels is monotonically increasing with energy. (auth)

7889 (NYO-3399-03) GENERALIZATIONS OF THE POMERANCHUK-OKUN' THEOREM. Balachandran, A. P.; Sudarshan, E. C. G. (Syracuse Univ., N. Y. Dept. of Physics). [1963]. Contract AT(30-1)-3399. 7p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The Foldy-Peierls formulation of the Pomeranchuk-Okun theorem is generalized to the scattering of multiplets belonging to the finite-dimensional unitary irreducible representations of any internal symmetry group. Corresponding theorems for nonforward and spin-flip amplitudes are also proven. (M.O.W.)

7890 (TID–22390) INFRAPARTICLE STRUCTURE AND FUNCTIONAL INTEGRALS. Tarski, Jan (Columbia Univ., New York. Dept. of Physics). [1965]. Contract AT(30-1)-755. 17p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

An investigation of functional integral representations, in terms of the fermion Green's functions for given external fields, was made. Some representations which involve the Hilbert space integral are presented. An analysis of the charged sectors of Schroer's model is presented. (M.O.W.)

7891 (TID–22452) RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY. Progress Report for the Period Ending November 30, 1965. (Syracuse Univ., N. Y.). Contract AT(30-1)-3399. 50p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Theoretical research toward the development of a theory for elementary particles is presented. Information is listed under separate heading of applications of the theory of symmetry groups, dynamics and dispersion relations, group theory, origin of symmetry and bootstraps, and field theory. (M.O.W.)

7892 (UCRL–12359(Rev.1)) WIGNER'S ANALYSIS OF THE UNITARY REPRESENTATIONS OF THE POINCARE GROUP. Halpern, Francis R.; Branscomb, Elbert (Lawrence Radiation Lab., Univ. of California, Livermore). Sept. 9, 1965. Contract W-7405-eng-48. 61p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

An exposition of Wigner's analysis of the irreducible unitary representations of the inhomogeneous Lorentz group is presented including the calculation of several useful ma-

trices and the detailed consideration of the structure of the various little groups and their representations. The theory of induced representations and little groups is briefly discussed in an appendix because it is the basis for Wigner's analysis and is of general applicability. (auth)

7893 UNITARY THEORY OF ELEMENTARY PARTICLES. Hautot, A. Bull. Soc. Roy. Sci. Liege, 34: 241-65 (1965). (In French).

A model based on the quantization of the mass of the nucleon deriving it from a neutral particle of mass equal to the neutron, called the electronon, was presented previously. The electronon was considered as the real elementary particle, from which the electron is derived by simple charge and the nucleon derived by association. It is shown by the present study that the proposed model can also be applied to known hyperon and meson particles. The base hypothesis remains the association law of the electronons: n being an integral number equal to 1, 2, ... 7 with an association of electronons, or shell, having a number $N = 16n^2$. A single shell of electronons is essentially unstable. It is shown that the quasi-stable mesons μ, π, K are binary associations of electronon shells with different parity. The quasi-stable baryons Λ, Σ, and Ξ are more complex associations, but well defined in shells. The shells which constitute the baryons are associated in such a way as to form, in each baryon, groups identical to the characteristic groups of the proton and neutron. Thus the association law and the parity rule which determine the existence and the properties of the neutron, proton, and deuteron determine also the existence of quasi-stable mesons and hyperons. The very stable hyperon and meson particles whose list is probably not completed result from the association of shells in a number higher than 2. All the observed decay modes of mesons and hyperons are derived from the numerical law of association through simple processes, implying only different reassociations of the shells accompanied by the energy annihilation of 1 or of several of the shells. By adding to the numerial association law and the parity law an interdiction principle relative to the nucleon, the reason for the maximum value of n being equal to 7 is justified and precisions are obtained on the structure of the nucleons. (tr-auth)

7894 THE HOMOMORPHY BETWEEN THE SU(2,2) GROUP AND THE CONFORM GROUP. Rideau, Guy Compt. Rend., 261: 3297-8(Oct. 27, 1965). (In French).

An application of the SU(2,2) group on the conform group is constructed explicitly and a global demonstration of the homomorphy between the two groups is thus obtained. (tr-auth)

7895 A CONTRIBUTION TO THE QUANTUM THEORY OF THE DECAY OF UNSTABLE ELEMENTARY PARTICLES. Khalfin, L. A. (USSR Academy of Sciences, Leningrad). Dokl. Akad. Nauk SSR, 162: 1034-7(June 11, 1965). (In Russian).

It is assumed that the properties of unstable elementary particles do not depend on the method of production or previous history of the particle. Ordinary unstable particles which decay by a weak interaction live for such a long time ($\sim 10^{-10}$ sec) that they can be completely characterized by a pole term in $\omega(E)$: $\omega(E) = C[(E - E_0)^2 + \Gamma^2]^{-1}$, where $\Gamma/E_0 \sim 10^{-15}$. Hence, experiments on the resonance scattering of decay products have such small cross-sections that this type of experiment cannot be carried out in practice. The energy resolution is so small (~ 1 Mev) that it is very difficult to detect effects due to Γ. In the decay of an unstable particle $m \rightarrow m_2 + m_3$, the energy distribution densities, which are determined by the decay interaction, have a purely kinematic character, and do not have anything in common with the energy distribution of the unstable particles. In cascade decay processes it is possible to have only a fast decay followed by a slow decay. This conclusion is a direct result of the law of conservation of energy and of the assumption that the properties of an unstable particle are independent of its mode of formation. (TTT)

7896 A NOTE ON BROKEN SU(3) SYMMETRY. Ghose, P. (Indian Association for the Cultivation of Science, Calcutta); Sen, S. Indian J. Phys., 39: 305(June 1965).

The $J^P = 3/2^+$ baryon decuplet decay into a baryon and a pseudoscalar meson octet was studied using the V-spin technique within the framework of broken SU(3). The ratio of two of the three parameters of the decay amplitude was estimated from the observed decuplet mass splittings. A second relation between the parameters was obtained from experimental decay widths. The results are tabulated. (L.B.S.)

7897 SU(3) SYMMETRY IN A BOOTSTRAP MODEL. Roy, T. (Jadavpur Univ., Calcutta); Ghose, P. Indian J. Phys., 39: 306(June 1965).

It is noted that considerations of the bootstrap conditions lead to full mass degeneracy among the eight physical vector meson (ρ, K^*, ϕ^0) and the SU(3) solutions for the coupling constants. It is emphasized that Cutkowsky's and Capp's assumption of mass degeneracy can be removed. (L.B.S.)

7898 ON THE ITERATION OF A SINGULAR INTEGRAL EQUATION. Pearson, D. B. (Hull Univ., Can.). Nuovo Cimento (10), 40A: 329-47(Nov. 21, 1965).

A method of iterating the singular integral equation of Omnès is given. The iteration is shown to converge provided the amplitude is sufficiently small. The conditions for convergence are related to the position of the bound-state pole, and to possible degeneracy of solutions of the equation. (auth)

7899 DYNAMICAL REARRANGEMENT OF SYMMETRIES. I. THE NAMBU-HEISENBERG MODEL. Umezawa, H. (Univ. Naples). Nuovo Cimento (10), 40A: 450-75(Nov. 21, 1965).

Certain aspects of the theory of dynamical breakdown of symmetries are examined. Since such theories begin with field equations possessing certain invariance properties, it might be argued that these invariance properties should not just disappear from the theory without leaving any trace. Thus it might be expected that some kind of rearrangement of invariance properties takes place in the dynamical process of going from the bare particles to the physical particles given by the theory. This conjecture turns out to be verifiable when the theory is formulated in such a manner that all Heisenberg operators are expressed in terms of field operators of physical particles (i.e., incoming particles). Specifically, it is found that the original invariance turns itself into the gauge invariance of a massless physical particle called the Goldstone particle. By making use of this formulation, several other characteristics are found which appear when the invariances are dynamically rearranged. Although the Nambu-Heisenberg model is used as an illustration, many of the results seem to be generally true. (auth)

7900 SOME REMARKS ON THE CONDITION Z = 0. Yoshimura, T. (Univ. of Nijmegen, Netherlands). Nuovo Cimento (10), 40: 492-501(Nov. 21, 1965).

It is shown that the condition Z = 0 does not mean the equivalence of theories with and without the field of the composite particle in the lagrangian. (auth)

7901 HIGH-ENERGY BEHAVIOUR OF FEYNMAN AMPLITUDES. Hamprecht, B. (Univ. of Cambridge, Eng.). Nuovo Cimento (10), 40A: 542-59(Nov. 21, 1965).

A method that is more general than existing ones is developed for the determination of the coefficient of the leading term in the high-energy expansions of an arbitrary Feynman integral. Some of the discussion is restricted to the case of heavy bosons having a φ^3 interaction, but it can be generalized to cover other types of Feynman integrals as well. (auth)

7902 A MAXIMUM PRINCIPLE FOR STRONG-INTERACTION SYMMETRIES. Bassetto, A. (Univ., Padua); Paccanoni, F.; Pusterla, M. Nuovo Cimento (10), 40A: 574-7(Nov. 21, 1965).

A method for obtaining a symmetry group for the strong interactions, starting with general dynamical assumptions

that involve unitarity, analyticity, and the strength of the input forces, is demonstrated, using the N/D equations. A set of selection rules reflecting lower symmetries is assumed, and the principle "for the partial waves where the forces are attractive, the highest-order nonvanishing invariant of the matrix C must be maximum consistently with the constraints imposed on the coupling by unitarity and analyticity" is added to it. The interaction of two sets of equal-mass pseudoscalar particles is considered, where the forces are due to the exchange of one vector meson, belonging to a mass-degenerate set, in the crossed channels; the SU(2) symmetry requirement is derived in this case. The results are extended to the P-wave scattering of eight pseudoscalar mesons with eight vector mesons providing the forces in the crossed channels, thus generating the SU(3) structure constants. (M.J.T.)

7903 SINGULARITIES AND DISCONTINUITIES OF THE TRIANGLE GRAPH, AS A FUNCTION OF AN INTERNAL MASS. Aitchison, I. J. R. (Cavendish Lab., Cambridge, Eng.); Kacser, C. Nuovo Cimento (10), 40A: 576-88(Nov. 21, 1965).

The triangle graph for three-body production or decay processes is considered as a function of an internal mass. The discontinuities of the graph with respect to this variable are of special importance, since they form the kernel of the integral equation which determines all rescattering effects due to competing two-body final-state interactions. The main part of the kernel is given by one particular discontinuity, and this is recalculated by dispersion methods which are basically well understood. The result agrees with that previously found by the use of Cutkosky's rules supplemented by some techniques of homology theory. A byproduct of the calculation is a prescription for calculating the discontinuity of the graph in a given channel from a single-variable representation of it in a crossed channel. Applications to three-particle processes are mentioned. (auth)

7904 U_{6W} PREDICTION FOR COLLINEAR PHOTOPRODUCTION PROCESSES. Dietz, K.; Drechsler, W. (CERN, Geneva). Nuovo Cimento (10), 40: 634-9(Nov. 21, 1965).

A hybrid U(6) symmetry, U(6W), suggested previously for collinear processes and whose generators are determined by the three W spin operators and the U(3) generators, is considered. The consequences of U(6W) invariance for collinear photoproduction of 0^- and 1^- mesons on nucleons are studied. Relations are obtained for various photoproduction cross sections, valid for both forward and backward direction. Expressions for the W-spin helicity amplitudes are obtained and presented for specific photoproduction reactions of octet baryons on protons. The one-particle-exchange model is also discussed in the framework of U(6W) symmetry. (M.J.T.)

7905 COPLANAR PHOTOPRODUCTION IN A $SU_3 \otimes SU_3 \otimes U_1$ SYMMETRY. Kupsch, J. (Univ., Bonn). Nuovo Cimento (10), 40A: 640-4(Nov. 21, 1965).

The subgroup G = SU(3+) ⊗ SU(3−) ⊗ U(1) of SU(6W) is studied for coplanar processes. Representations of G are given for the quarks and antiquarks, the antimeson and meson nonets, octets, and singlet, and the antibaryon and baryon decuplets and octets. The scheme is applied to photoproduction processes on nucleons, using the tensor method of calculation. Representations derived for the photoproduction of 0^- or 1^- mesons and $\frac{1}{2}^+$ or $\frac{3}{2}^+$ baryons are presented, and the numbers of independent invariant amplitudes predicted by G and by SU(3) invariance for each process are compared. The case for an incoming antinucleon is considered. Relations among the amplitudes for the various processes are obtained. (M.J.T.)

7906 ON BARGMANN-WIGNER THEORY FOR PARTICLES OF SPIN 2. Vidal, A.; MacDowell, S. W. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo Cimento (10), 40A: 645-6(Nov. 21, 1965).

A tensor formulation of the Bargmann-Wigner equations for spin-2 particles is presented, by means of forming covariant tensors out of the product of the symmetric Dirac matrices and the Bargmann-Wigner wave function. It is found that the Bargmann-Wigner theory contains two independent but equivalent theories for particles of spin 2. (M.J.T.)

7907 THE N/D METHOD AND THE DIFFRACTION PICTURE. II. Olesen, P.; Smith, J. (Univ., Copenhagen). Nuovo Cimento (10), 40A: 659-61(Nov. 21, 1965).

A method used previously to find restrictions on the high-energy behavior of Im D by combining the boundary condition that the P-wave scattering amplitude satisfies the diffraction picture at high energies and the N/D method is examined for the case of ρ-meson production in $\pi-\pi$ scattering. It is assumed that $\mathrm{Im}\, D_1(\nu) \approx \mathrm{const}/\sqrt{\nu}$ at high energy, where ν is the cms momentum, and that $N_1(\nu)$ is proportional to the Born approximation at low energy. It is found that there is no point ν_T above which the amplitude is purely absorptive, when there is a low-energy resonance, under the hypothesis that there is a sharp transition between the low-energy Born amplitude and the high-energy diffraction picture. The results assuming a smooth transition are also inconsistent with the previous method. (M.J.T.)

7908 PARITY CONSERVATION AND COMPOSITENESS. Cook, P. A. (Univ. of Manchester, Eng.). Nuovo Cimento (10), 40A: 670-3(Nov. 21, 1965).

It is shown that, in simple models starting from invariance under C and any internal symmetry group present, parity-violating solutions do not occur in the formulation of the bootstrap mechanism throught the compositeness conditions of Salam. The proof depends essentially on the properties of gamma matrices. Consideration is given to the case of a neutral spin-0 boson interacting with a spin-$\frac{1}{2}$ fermion through the coupling $\psi\,(x + y\gamma_5)\,\psi\,\phi$, the case where ψ and ϕ belong to representations of an internal symmetry group, the case in which two different fermion fields interact with a boson field through the coupling $[\psi_1(x + y\gamma_5)\psi_2 + \psi_2(x^* + y^*\gamma_5)\psi_1]\phi$, assuming C invariance, and finally the latter case where the assumption of C invariance is dropped. (M.J.T.)

7909 THE COLLINEAR GROUPS $(SU_3 \otimes SU_3)_{coll}$ AND $(SU_2 \otimes SU_2 \otimes W\,(\sigma_z Y))_{coll}$. Buccella, F. (Univ. Florence, Italy; Gatto, R. Nuovo Cimento (10), 40A: 684-9(Nov. 21, 1965).

Physical implications of the collinear groups $[SU(3) \otimes SU(3)]_{coll}$ and $[SU(2) \otimes SU(2) \otimes W(\sigma_z Y)]_{coll}$ are discussed. The first group is the collinear subgroup of SU(6); the second is obtained from the first by restricting the internal symmetry to that of isospin and hypercharge conservation. The quark, baryon, and meson assignments are described. Predictions of these groups are considered for the amplitudes of hyperon nonleptonic decays, collinear photoproduction amplitudes, meson mass formulas, proton-antiproton annihilation at rest, and magnetic moments of strange baryons. (M.J.T.)

7910 MESIC GAUGE INVARIANCE AND SYMMETRIES OF FERMI PARTICLES INTERACTIONS. Petermann, A. (CERN, Geneva). Nuovo Cimento (10), 40A: 1-12(Nov. 1, 1965).

A principle of invariance under a continuous local group of transformations — the mesic gauge — is investigated. If the nucleons have equal bare masses with respect to the electromagnetic interaction — an hypothesis which might be strongly supported by a proposed experiment on the K-mesons mass difference — the principle of invariance includes for the nucleon doublet: a charge-independent interaction with a pseudoscalar meson field; forced P conservation in this interaction; selection of exclusive vector interactions with the lepton currents; and allowable parity nonconservation in these interactions (V, A form). For the (μ,ν) and (e,ν) doublets, the V, A parity nonconserving interaction is similarly selected. However, here the origin of mass of the charged particles is not discussed. P symmetry in strange-particle strong interactions is finally established in a specific example for baryons of equal bare mass as a consequence of mesic gauge invariance. 8 vector mesons must be introduced. (auth)

7911 NOETHER'S THEOREM AND GAUGE GROUPS. Lopez, C. A. (International Centre for Theoretical Physics, Trieste). Nuovo Cimento (10), 40A: 19-30(Nov. 1, 1965).

It is shown that the usual association of a conservation law to a continuous symmetry group given by Noether's theorem is only correct when the group can be defined by means of a finite number of parameters. This is the case, for instance, of the inhomogeneous proper Lorentz group and of the phase groups. The meaning of Noether's theorem for those groups, like the gauge groups, that cannot be expressed with a finite number of parameters, is discussed in detail. In addition to the well-known gauge transformations of the first and second kind, more general gauge groups of the Yang-Mills type are also considered. (auth)

7912 NONPERTURBATIVE SOLUTIONS IN A FIELD THEORY WITH Sp_6 SYMMETRY. Ladanyi, K. (Research Group for Theoretical Physics, Hungarian Academy of Sciences, Budapest). Nuovo Cimento (10), 40A: 31-64(Nov. 1, 1965).

An Sp_6-invariant nonlinear spinor equation is introduced and discussed. The covariant Fock equations are considered by using nonperturbative methods based on appropriate decompositions of many-point amplitudes. An exact Sp_6 symmetry is assumed taking into account the possible spontaneous breakdown of the γ^5-invariance. In order to avoid the divergence difficulties, some self-consistent boundary conditions are imposed to be satisfied by the two- and three-point amplitudes for vanishing relative co-ordinates. A kind of eigenvalue problem is obtained for the couplings and masses. The results indicate that an acceptable solution of the problem is not excluded. This possibility is connected with the simultaneous occurrence of the interactions generated by trion-antitrion pairs characterized by spin zero and one. The coupling generated by pseudoscalar pairs is a derivative one. For pseudoscalar trion-antitrion amplitudes the fulfillment of the self-consistent boundary conditions is discussed in detail in the framework of nonperturbative methods. The possibility of the spontaneous medium-strong breakdown of the Sp_6-invariance is also discussed in detail. (auth)

7913 THE DIFFERENCE IN THE KINEMATICS OF THE HIGH-ENERGY CROSSING IN REGGE FORMALISM FOR EQUAL AND NONEQUAL MASSES. Sakmar, I. A. (Univ. of Miami, Fla.). Nuovo Cimento (10), 40A: 76-83 (Nov. 1, 1965).

Given a physical channel the high-energy crossing from the other two channels both for equal and nonequal-mass particles was investigated. Results are interpreted on the Mandelstam diagram and some restrictions are found in the case of nonequal masses. (auth)

7914 ON THE QUANTUM THEORY OF FIELDS ASSOCIATED WITH SIMPLE MODELS OF NON-LINEAR WAVE EQUATIONS. Petiau, G. (Univ., Paris). Nuovo Cimento (10), 40A: 84-101(Nov. 1, 1965). (In French).

Two models of nonlinear wave equations are studied, which give representations for scalar or vectorial particles with scalar or vectorial self-fields. Hamiltonian representations of classic field theories associated with the nonlinear wave equations are built. New quantum field theories are proposed for the introduced models. They are generalizations of the usual quantum field theory but the masses are quantized in parallelism with the amplitudes. (auth)

7915 THE REPRESENTATIONS OF SYMMETRY GROUPS ON THE ALGEBRA OF QUASI-LOCAL OBSERVABLES. Montvay, I. (Lorand Eoetvoes Univ., Budapest). Nuovo Cimento (10), 40A: 121-31(Nov. 1, 1965).

Operator representations of a symmetry group G on the algebra introduced by Haag and Kastler are investigated. Considering the representation of the Lorentz group the stability condition can be formulated with the help of the infinitesimal operators on the algebra itself. The connection between the representations of G on the algebra and on the Hilbert space of its G-invariant *-representations is discussed. A necessary and sufficient condition for the G-invariance of a *-representation R is obtained. If R contains a G-invariant state, this condition is fulfilled and the spectrum of the infinitesimal operators on the Hilbert space of R is included in the spectrum of the corresponding infinitesimal operators on the algebra. (auth)

7916 UNITARITY AND THE BOUND-STATE PROBLEM IN ALMOST LOCAL FIELD THEORY. Martinis, M. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 40A: 132-49(Nov. 1, 1965).

The possibility of imposing the condition of almost locality on a 4-point matrix element is demonstrated in order to obtain certain restrictions on the functions appearing in the Haag expansion of an almost local field. Disregarding possible end-point singularities it is shown that in a certain finite energy region these functions satisfy equations similar to physical unitarity. Assuming that the F-functions appearing in the Haag expansion possess analytic properties a model is found which explicitly shows how the end-point singularity can be cancelled by the threshold behavior if the energy region is restricted to the elastic region. It is also shown how the bound-state problem may be incorporated into the spirit of almost local field theory. The problem is analyzed in the case of AB elastic scattering where B represents a two-particle bound state of A. (auth)

7917 REDUCTION OF FEYNMAN DIAGRAMS. Melrose, D. B. (Oxford Univ.). Nuovo Cimento (10), 40A: 181-213(Nov. 1, 1965).

Formulas expressing the amplitude for a Feynman diagram consisting of a single internal loop with n sides and n external lines as a sum of its reduced diagrams are derived by applying restrictions imposed by the finite dimensionality of space-time on the unparametrized amplitude. In 4-dimensional space-time these formulas express the amplitude for the n-sided diagram as a sum of all its 5-sided reduced diagrams; this can be further expressed as a sum of all its 4-sided reduced diagrams. The coefficients in each sum depend only on the external invariants and internal masses. (auth)

7918 BROKEN SYMMETRIES AND THE ELECTRON MUON PROBLEM. [PART] II. Maris, Th. A. J.; Herscovitz, V. E.; Jacob, G. (Univ. do Rio Grande do Sul, Porto Alegre, Brazil). Nuovo Cimento (10), 40A: 214-24(Nov. 1, 1965).

After some general remarks on massless quantum electrodynamics it is shown that the lowest-order Dyson equations compel the lepton propagators of one and of two charged neutrino fields to be parity invariant. (auth)

7919 ELECTROMAGNETIC FORM FACTORS. [PART] II. Gourdin, M.; Micheli, J. (Univ. de Paris, Orsay, France). Nuovo Cimento (10), 40A: 225-35 (Nov. 1, 1965).

A covariant formulation of the electromagnetic form factors for spin-$\frac{3}{2}$ particles was studied in the Rarita-Schwinger formalism. The relation between the covariant form factors and the physical form factors is given explicitly. The covariant formulation is then extended to particles with integral and half-integral spins. (tr-auth)

7920 SOME CONSEQUENCES OF $\tilde{U}_{12}$ WITH SU_3 BREAKING. Babu, P. (Tata Inst. of Fundamental Research, Bombay. International Centre for Theoretical Physics, Trieste). Nuovo Cimento (10), 40A: 261-4 (Nov. 1, 1965).

An attempt is made to find the relations that would follow if $\tilde{U}_{12}$ is broken by a spurion which transforms like a member of the 143 representation of the $\tilde{U}_{12}$, which is a scalar under the $\tilde{U}_4$ subgroup and the eighth member of the octet under the SU_3 subgroup. The effect of such a symmetry-breaking for the decuplet decays and the baryon-meson scattering is considered. In particular it is found that the difficulties of the exact symmetry associated with the prediction of vanishing polarization for the outgoing baryon in certain baryon-meson reactions are not removed by the inclusion of such a breaking. (L.B.S.)

7921 NEGATIVE-PARITY BARYON RESONANCES AND BROKEN $SU_6 \times SU_6$ SYMMETRY. Volkov, D. V. (CERN, Geneva). Nuovo Cimento (10), 40A: 281-3(Nov. 1, 1965).

Three different possible assignments of representations of the $SU_6 \times SU_6$ group, (1,70), (15,6), and (21,6), to the negative-parity baryon resonances, and the consequences which follow for the interaction of these resonances with (56,1) baryonic and $(6,\bar{6})$ mesonic $SU_6 \times SU_6$ multiplets are considered. (L.B.S.)

7922 NORMALIZATION OF WAVE FUNCTIONS AND WAVE-FUNCTION RENORMALIZATION CONSTANTS. Lurie, D.; Takahashi, Y. (Inst. for Advanced Studies, Dublin). Nuovo Cimento (10), 40A: 295-8(Nov. 1, 1965).

A method which was previously described for deriving the normalization condition for Bethe-Salpeter wave functions is used to derive the normalization of residues of poles in general Green's functions. The method is illustrated for the case of a dressed one-particle propagator. (L.B.S.)

7923 MOMENTA AND MASS OPERATORS IN COMBINED INVARIANCE THEORIES. Mirman, R. (Long Island Univ., Brooklyn). Nuovo Cimento (10), 40A: 309-10(Nov. 1, 1965).

It was previously shown that algebras containing the Poincaré algebra as a subalgebra can be divided into four classes. It is shown that the eigenvalues of each of the momenta and the mass operator in all four cases are zero. It is concluded that in order to include the momenta in any combined invariance theory continuous spectra are required. (L.B.S.)

7924 WEAK AND ELECTROMAGNETIC CURRENTS WITH A POLE MODEL IN $U_{(6,6)}$. Ademollo, M.; Buccella, F.; Gatto, R. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence). Nuovo Cimento (10), 40A: 311-15(Nov. 1, 1965).

An investigation was made of some of the direct consequences of the assumption of meson dominance, with $U_{(6,6)}$-invariant strong interaction vertices and an extrapolation procedure based on the appropriate propagators of the linearized meson theory. Vector currents are derived in terms of the proton charge and magnetic moment. (L.B.S.)

7925 ON THE GAUGE AND RELATIVISTIC INVARIANCE IN QUANTUM ELECTRODYNAMICS. Chahoud, J. N. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna); Russo, G. Nuovo Cimento (10), 40A: 319-22(Nov. 1, 1965).

An attempt is made to show how the appropriate relativistic requirement, at the level of conventional field theory, can throw some new light of the questions of gauge invariance and its connection to the Lorentz group. (L.B.S.)

7926 ON SINGULAR POTENTIAL SCATTERING. II. Del Giudice; E.; Galzenati, E. (Univ., Naples). Nuovo Cimento (10), 40A: 739-47(Dec. 1, 1965).

Asymptotic expansions of tan δ in the weak coupling limit, are derived for scattering by inverse-power singular potentials in higher waves, and for scattering by a superposition of two inverse-power singular potentials. These results are obtained by the same approach followed in a previous paper. (auth)

7927 A NUMERICAL INVESTIGATION OF THE RANDOM-PHASE METHOD IN HIGH-ENERGY SCATTERING. Kumar, R. C.; Squires, E. J. (Univ. of Durham, N. C.). Nuovo Cimento (10), 40A: 756-60(Dec. 1, 1965).

The validity of the arguments previously used to apply the random-phase assumption to the N-over-D treatment of high-energy scattering is investigated by a simple numerical treatment using 10×10 matrices where elements have random signs. The statistical fluctuations are small for the diagonal element, but for the off-diagonal elements they are not negligible. (auth)

7928 N/D EQUATIONS WITH A FINITE STRIP. Jones, C. E. (Princeton Univ., N. J.). Nuovo Cimento (10), 40A: 761-87(Dec. 1, 1965).

A rather complete treatment is given of N/D equations where the D function has only a finite cut. The original work of Chew on such equations is reviewed and expanded to prove the existence of solutions whenever $\delta_1(s_A) < \pi$ and to reduce the integral equation for N in these cases to a combined Wiener-Hopf-Fredholm type. An explicit formula for the Wiener-Hopf resolvent kernel is obtained which involves a single integral over products of hypergeometric functions. CDD ambiguities are investigated, and maximal analyticity of the second degree, or analyticity in angular momentum, is demonstrated as a tool for removing all ambiguity from the solution. (auth)

7929 V-θ SECTOR OF THE LEE MODEL. I. CURRENT OPERATORS AND SCATTERING STATES. Vaughn, M. T. (Northeastern Univ., Boston). Nuovo Cimento (10), 40A: 803-21(Dec. 1, 1965).

By a slight extension of Amado's method, the matrix elements of the current operators between physical scattering states in the V-θ sector of the Lee model are determined. Then the coefficients of the expansion of the scattering states in terms of the noninteracting states and the S-matrix elements are computed. The production amplitude is exhibited as a product of the contribution of pole diagrams times a simple correction factor which contains the effect of initial- and final-state interactions. (auth)

7930 ANALYTICITY PROPERTIES AND ASYMPTOTIC BEHAVIOR OF THE NONRELATIVISTIC SCATTERING AMPLITUDE BY FIELD-THEORETIC TECHNIQUES. Cirelli, R.; Montaldi, E.; Prosperi, G. M. (Univ., Milan). Nuovo Cimento (10), 40A: 846-67(Dec. 1, 1965).

In the framework of a momentum-space method proposed by Bell, techniques borrowed from perturbation field theory are applied to the study of the analyticity properties and asymptotic behavior of the nonrelativistic scattering amplitude. Attention is given to an ordinary local potential superposition of Yukawa potentials. The technique developed has particular interest, however, also for application to velocity-dependent potentials. (auth)

7931 BARYON-MESON COUPLINGS AND BARYON MAGNETIC MOMENTS IN A RELATIVISTIC GENERALIZATION OF THE WIGNER SU_4 SUPERMULTIPLET THEORY. Nuyts, J.; Straumann, N. (CERN, Geneva). Nuovo Cimento (10), 40A: 868-73(Dec. 1, 1965).

A few models using inhomogeneized groups for baryon-meson couplings and magnetic moments are discussed with a special emphasis on the ISL(4,C) group. Many ambiguities implicit in preceding papers are shown to exist in these models. (auth)

7932 ZERO-MASS BOSONS AND SINGULARITIES IN A RELATIVISTIC MODEL WITH A SPONTANEOUSLY BROKEN SYMMETRY. Bassetto, A.; Ciccariello, S. (Univ., Padova). Nuovo Cimento (10), 40A: 874-80(Dec. 1, 1965).

Some Çreen functions are studied in a simple relativistic model in order to clarify the connection between symmetry breakdown of the superconductive kind and the presence of massless particles. (auth)

7933 THE PROJECTIVE GROUP AS A REALIZATION OF THE SU(N,1) GROUP. Giovannini, A.; Gliozzi, F. (Univ. Torino, Italy). Nuovo Cimento (10), 40A: 881-6 (Dec. 1, 1965).

The dynamical group of the N-dimensional harmonic oscillator is a realization in terms of creation and destruction operators of the projective group of linear fractional transformations. A suitable contraction on this group yields the group SU_N as the degeneracy group of the system. (auth)

7934 KINEMATICAL FORM FACTORS IN THE PERIPHERAL MODEL. Duerr, H. P. (Max-Planck-Institut fuer Physik and Astrophysik, Munich); Pilkuhn, H. Nuovo Cimento (10), 40A: 899-912(Dec. 1, 1965).

In potential theory the vertex functions for resonance formation contain kinematical form factors, which depend on the spin of the resonance and are simply related to penetration factors. Analogous form factors are introduced for the relativistic vertex functions of the one-pion-exchange model. The resulting vertex functions behave like the Born term functions near the pion pole but go to constants as the momentum transfer goes to infinity, for arbitrary resonance spin. For elastic nucleon-nucleon scattering, the total form factor reduces to a simple pole. (auth)

7935 SOME REMARKS ON THE BETHE-SALPETER NORMALIZATION PROPERTIES. Predazzi, E. (Univ. of Chicago). Nuovo Cimento (10), 40A: 913-27(Dec. 1, 1965).

The Bethe-Salpeter normalization condition is investigated, and a unified picture of the different methods so far used is given together with their equivalence proof. The solutions of the Bethe-Salpeter equation are then examined in the Wick-Cutkosky model for $n = l + 1$ for a check of the recent result of Nakanishi that abnormal solutions with odd x correspond to states with negative norm. This result is confirmed for $n = l + 1$ and arbitrary x in the energy range $0 < s \ll n/(n + x)(n + x + 1)$ for which it is proved that the solution can be well approximated by the zero energy solution. (auth)

7936 A VARIATIONAL PROCEDURE FOR THE STATISTICAL MECHANICS OF A MANY-BOSON SYSTEM. Friedman, M. H. (Northeastern Univ., Boston). Nuovo Cimento (10), 40B: 87-98(Nov. 11, 1965).

A variational procedure due to Husimi is applied to the many-boson problem in an effort to find an approximate density matrix. The results are identical to those previously obtained by Wentzel employing another technique. The procedure differs primarily in that it is not limited to hamiltonians of any specific form. (auth)

7937 TWO-PARTICLE CORRELATION FUNCTION AND CONSERVATION LAWS. III. Picman, L. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Nuovo Cimento (10), 40B: 118-33(Nov. 11, 1965).

The Bethe-Salpeter type of equation in momentum space for the temperature-dependent equilibrium correlation function is used to analyze the question of what approximations in the kernel Ξ and the self-energy part Σ conserve particle number as well as total energy and momentum. It is shown that this is equivalent to asking the Ξ, Σ, and G to satisfy five special identities. A simple diagrammatic analysis shows that these identities are satisfied whenever the kernel $\Xi(G)$ is derived from opening all the propagator lines G of the self-energy part $\Sigma(G)$. As an example, the linearized Boltzmann equation is considered. The customary microscopic conservation laws for energy and momentum are derived as a first-order expansion in the wave-vector q. (auth)

7938 STABILITY CONDITIONS FOR A BOSON SYSTEM INTERACTING WITH A PARTLY REPULSIVE AND PARTLY ATTRACTIVE POTENTIAL. Coniglio, A.; Marinaro, M.; Maturi, M. (Univ., Naples). Nuovo Cimento (10), 40B: 184-96(Nov. 11, 1965).

The properties of a dilute system of Bose particles with a short-range repulsive and a long-range attractive potential are studied. Some conditions on the scattering amplitude are found to assure the thermodynamic stability of the system. The method developed by Belyaev is used for calculating the ground-state energy and the elementary excitation spectrum of the system. The results are compared with those of Huang, Ezawa, and Iordanskii and are found to be in complete agreement. (auth)

7939 MAGNETIC MOMENTS OF SPIN 1/2 PARTICLES IN EXTERNAL FIELDS. Greenberg, O. W. (Univ. of Maryland, College Park. Rockefeller Univ., New York). Phys. Lett., 19: 423-4(Nov. 15, 1965).

The magnetic moment of a spin $\frac{1}{2}$ particle is calculated for external pseudoscalar and pseudovector potentials entering the Dirac equation as $V(|p|)\gamma^5$ and $iV(|p|)\gamma^0\gamma^5$ respectively, where V is real. Momentum dependent potentials are allowed, since the momentum dependence is of some interest in the pseudovector case. The magnetic moments and energy versus type of external field are given. (J.F.P.)

7940 FORM FACTORS FOR WEAK AND ELECTROMAGNETIC DECIMET-OCTET TRANSITIONS. Oehme, R. (Univ. of Chicago). Phys. Lett., 19: 518-21(Dec. 1, 1965).

Results are presented which can be obtained for the form factors in the decimet-octet matrix elements of vector and axial vector currents. It is shown that all these form factors can be expressed for all values of q^2 in terms of the magnetic form factor of the proton and the axial form factors for neutron beta decay. If a pole model is adopted, then essentially all the parameters appearing in the form factors are determined in the scheme. It is assumed that the fundamental structure of the weak interactions can be determined on the basis of algebras generated by the components of lepton and hadron currents. Then these interactions exhibit γ_5 symmetry, which may be a characteristic feature of the physics in very small dimensions. (J.F.P.)

7941 SYMMETRY PROPERTIES OF STRONG INTERACTIONS. Matthews, P. T. (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), Ser. A, 288: 147-55(Oct. 26, 1965).

The predictions of unitary symmetry are reviewed in relation to the current experimental situation. Mass relations and electromagnetic effects implied by SU(3) invariance are briefly reviewed; and the successes of SU(6) symmetry are outlined. (L.B.S.)

7942 HIGHER SYMMETRY SCHEMES FOR STRONG INTERACTIONS. Van Hove, L. (CERN, Geneva). Proc. Roy. Soc. (London), Ser. A, 288: 156-60(Oct. 26, 1965).

Some extensions of SU(3) symmetry which have been recently proposed are reviewed. Investigations on basic SU(3) triplets-quarks, basic SU(3) triplets with integral charge, the existence of additional basic particles and higher symmetry schemes, and interactions leading to higher symmetry schemes are outlined. (L.B.S.)

7943 WEAK INTERACTIONS AND UNITARY SYMMETRY. Cabibbo, N. (CERN, Geneva). Proc. Roy. Soc. (London), Ser. A, 288: 161-5(Oct. 26, 1965).

The recent advances in the understanding of leptonic weak interactions that have been made possible by the discovery of approximate SU_3 symmetry of strong interactions are briefly reviewed. (L.B.S.)

7944 WEAK INTERMEDIATE BOSONS AND UNITARY SYMMETRY. d'Espagnat, B. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Proc. Roy. Soc. (London), Ser. A, 288: 166-9(Oct. 26, 1965).

The questions on the existence of bosons, and unitary symmetry for bosons are considered; and some predictions of the two classes of current-current theories of weak interactions which account for the nonleptonic $\Delta I = \frac{1}{2}$ rule are compared. It is argued that the theories which account for the $\Delta I = \frac{1}{2}$ rule through the basic structure of the weak interaction intermediate bosons have some implications in unitary symmetry. The hypothesis of the intermediate bosons as trions and PC violation are briefly considered. (L.B.S.)

7945 TESTS OF UNITARY SYMMETRY IN STRONG INTERACTIONS. Lipkin, H. J. (Argonne National Lab., Ill.). Proc. Roy. Soc. (London), Ser. A, 288: 170-82 (Oct. 26, 1965).

The dynamics of systems of muons and charged pions without strong interactions are examined in order to point out how a system may have some properties indicating an underlying SU(3) symmetry, which is not apparent in the exact Lagrangian and which breaks down in very peculiar ways. The various types of experimental predictions that can be made from unitary symmetry are considered: classification; transition rates; and multibaryon states. Some possible tests for higher symmetries are also examined. (L.B.S.)

7946 DEVIATIONS FROM UNITARY SYMMETRY FOR RESONANT STATES. Dalitz, R. H. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 288: 183-99(Oct. 26, 1965).

Some theoretical investigations on symmetry breaking interactions are reviewed. The physical conditions under which the threshold energy differences do not produce large deviations from unitary symmetry for members of a unitary multiplet are discussed. The boundary condition model is presented for the description of a resonant state involving two-particle meson channels. Dispersion theory and the structure of decuplet states are treated. Two examples are studied for the case $l = 0$: the s-wave baryon-baryon interaction, and the Y_0^* (1405) resonance. (L.B.S.)

7947 ANALYTICITY IN POTENTIAL SCATTERING. Martin, Andre (Inst. for Advanced Study, Princeton, N. J.). Progr. Elem. Particle Cosmic Ray Phys., 8: 1-66(1965).

The analytic properties of scattering amplitudes in potential scattering are treated, beginning with the one-dimensional Schroedinger equation for describing the partial-wave scattering amplitudes. Fixed transfer dispersion relations and Lehmann ellipse are studied, following closely the method of Klein and Zemach. The analytical properties of each successive term of the Born series are then studied. The result of Blanckenbeckler, Goldberger, Khuri and Treiman is reviewed, that the full scattering amplitude can be calculated using the Mandelstam representation and the elastic unitary condition and knowing the first Born approximation. Complex angular momentum is treated using the Regge approach and the perturbation approach. (L.B.S.)

7948 STRONG INTERACTIONS SYMMETRY. Ne'eman, Yuval (Israel Atomic Energy Commission, Yavne. Tel-Aviv Univ., Israel). Progr. Elem. Particle Cosmic Ray Phys., 8: 67-121(1965).

The two main lines of thought that motivated the search for a protosymmetry (parent symmetry) are reviewed together with an analysis of the various types of symmetry as they evolved. The octet protosymmetry is then treated, including mathematical structure, reaction parameters, particle and resonance assignments, and predictions of symmetry-breaking effect. Some dynamical mechanisms that have been suggested to check the self-consistency of the system are studied. (L.B.S.)

7949 COMPLEX ANGULAR MOMENTUM IN NUCLEAR-COULOMB SCATTERING. Mentkovskii, Yu. L. (Inst. of Physics, Academy of Sciences, Kiev). Ukr. Fiz. Zh., 10: 952-9(Sept. 1965). (In Ukrainian).

Analytical methods are applied to the study of potential scattering. Regge's idea is extended to the case of Coulomb scattering on nuclear Coulomb potential $V(r) = a/r + v(r)$; $a > 0$; $\int_0^\infty dr|v(r)| < \infty$. The Legendre polynomial expansion is applied to the difference between the total and the purely Coulomb amplitudes (instead of to the total scattering amplitude). Since the denominator of the partial amplitude is a Jost function, it is not difficult to introduce the Regge trajectory concept. (ATD)

7950 MASS RELATIONS FOR MIXING OF TWO IRREDUCIBLE REPRESENTATIONS IN SU(3) SYMMETRY. Menski, M. B. (Moscow State Univ.). Yadern. Fiz., 2: 897-905(Nov. 1965). (In Russian).

Mass relations for the reducible unitary multiplet which is the mixture of two irreducible multiplets are derived in the first order of moderately strong interactions. (D.C.W.)

7951 EIGENFUNCTIONS OF THE LAPLACE OPERATOR AND METHOD OF GRAPHS. Vilenkin, N. Ya.; Kuznetsov, G. I.; Smorodinskii, Ya. A. Yadern. Fiz., 2: 906-17(Nov. 1965). (In Russian).

A graphical method for the solution of the multi-dimensional Laplace equation is considered. Solutions are used to obtain the representations of the groups U(2), SU(2), SO(3), U(3), SU(3). (auth)

7952 BARYON-BARYON SCATTERING AT LOW ENERGY AND THE SU(6) SYMMETRY. Zakharov, V. I.; Tyutin, I. V. (Inst. of Experimental and Theoretical Physics, State Atomic Energy Commission, USSR). Yadern. Fiz., 2: 918-21(Nov. 1965). (In Russian).

Baryon-baryon scattering is studied in the SU(6) symmetry approximation. It is shown that the cross sections of all the processes are determined by two independent amplitudes and show resonance behavior. The numerical results for the scattering length are inconsistent with the experimental data. (D.C.W.)

7953 ELECTROMAGNETIC PROPERTIES OF THE 70-PLET. Dolgov, A. D. (Inst of Experimental and Theoretical Physics, State Atomic Energy Commission, USSR). Yadern. Fiz., 2: 922-7(Nov. 1965). (In Russian).

The relations between the magnetic moments and the electromagnetic mass differences in the baryon 70-plet are obtained. It is assumed that the electromagnetic current operator transforms according to the 35-representation of the group SU(6) and that the interaction responsible for the splitting is proportional to the square of the current. (auth)

7954 LOWER LIMIT OF THE BACK SCATTERING CROSS SECTION. Arushanov, G. G. (Inst. of Physics, Academy of Sciences, USSR). Yadern. Fiz., 2: 938-9 (Nov. 1965). (In Russian).

The Lagrange method of finding conditional extrema was used to obtain a formula for the lower limit of the backscattering cross section in terms of the total cross sections and the ratio of the real and imaginary parts of the forward scattering amplitude. (auth)

7955 MOMENTA OF SPECTRAL FUNCTIONS AND VALUES OF RENORMALIZATION CONSTANTS IN QUANTUM FIELD THEORY. Khriplovich, I. B. Yadern. Fiz., 2: 950-3(Nov. 1965). (In Russian).

Relations connecting the spinor field mass with the spectral functions of the Lehmann representation are derived with the help of the equations of motion for the Heisenberg operators. An analysis of one of these equations in the pseudoscalar meson theory shows that the renormalization constant of the vertex part $Z_1 = 0$. A similar result holds for quantum electrodynamics, at least for the Feynman gauge. (auth)

7956 VIOLATION OF BARRIER PENETRATION SYMMETRY FOR COMPOSITE PARTICLES. Amirkhanov, I.; Zakharev, B. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 49: 1097-1102(Oct. 1965). (In Russian).

For elementary particles the penetrability of any barrier in opposite directions is strictly the same. However the penetration coefficients for nonsymmetric barriers in opposite directions may be very different for composite particles if their energy is sufficient for exciting the higher states of the internal movement. This effect should appear in various atomic and nuclear phenomena. (auth)

7957 ON MASS RENORMALIZATION IN GENERALIZED FIELD THEORY. Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 49: 1161-8(Oct. 1965). (In Russian).

Renormalization of the boson mass is studied by using as an example the polarization operator in the second order of pseudoscalar meson theory extended to the case of constant curvature momentum space. It is shown that a result of renormalization is a "spreading out" of the particle mass. (auth)

7958 DYNAMICAL THEORY OF GROUPS AND FIELDS. DeWitt, Bryce S. Documents on Modern Physics. New York, Gordon and Breach, 1965. 262p. $2.95 paper; $5.95 cloth.

The extension of quantum theory to fields possessing non-Abelian infinite dimensional invariance groups is discussed. The topics discussed include invariance groups, measurement of two observables (uncertainty principle), Green's

functions, reciprocity relations, Poisson-Jacobi identity, canonical theory, asymptotic invariants, field quantization, continuous groups, Yang-Mills group, coordinate transformation group, metric and spin, anticommuting fields, specific lagrangians, bi-tensors and bi-spinors, conservation laws, canonical transformation group, Schwinger variational principle, S-matrix, quantum action functional, external field problems, renormalization, and radiative corrections for non-Abelian gauge groups. (C.E.S.)

Fluid Physics and Thermodynamics

See *also* Plasma Physics and Thermonuclear Processes

Refer also to abstract 7159.

7959 (ANL-7063) SOME TOPICS IN STATISTICAL MECHANICS. (Molecular Distribution Functions, Cluster Expansions, etc.). A Series of Lectures. Nijboer, B. R. A. (Argonne National Lab., Ill.). June 1965. Contract W-31-109-eng-38. 66p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The pair distribution function is discussed. Its definition, properties, and cluster expansion are discussed in terms of ensembles and the Liouville theorem, molecular distribution functions, the one-dimensional system, and the Mayer cluster expansions. (M.O.W.)

7960 (LA-DC-7462) SHOCK WAVE RESEARCH ON INERT SOLIDS. Deal, W. E. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 46p. (CONF-651003-8). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From 4th Symposium on Detonation, Silver Spring, Md.

A literary survey of shock wave research on inert solids is presented. A discussion of various aspects of the research is presented. Polymethyl methacrylate data taken from the references are presented. (M.O.W.)

7961 (NASA-TN-D-3144) ROLE OF CONDUCTIVITY IN HYDROMAGNETIC STABILITY OF PARALLEL FLOWS. Nachtsheim, Philip R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center); Reshotko, Eli (Case Inst. of Tech., Cleveland, Ohio). Dec. 1965. 24p. CFSTI $1.00 cy, $0.50 mn.

The role of the electrical conductivity in the stability of magnetohydrodynamic channel flow with parallel magnetic field is examined through exact numerical solution of the pertinent sixth-order system of disturbance equations throughout an extended range of magnetic Reynolds numbers. The results obtained indicate that the conductivity of the fluid acts as a stabilizing agent, as long as it is small, and as a destabilizing agent, if it is large. It is concluded that the conductivity reverses its role as a stabilizing agent at a magnetic Reynolds number of order unity. Examination of the contributions to a disturbance energy balance equation shows that the conductivity acts as a destabilizing agent by setting up a time-independent Maxwell stress that has the same sign as the vorticity of the basic flow. (auth)

7962 SHOCK PROPAGATION IN TRANSVERSE MAGNETIC FIELDS. Nation, J. A. (Central Electricity Research Labs., Leatherhead, Eng.). Brit. J. Appl. Phys., 16: 1693-8(Nov. 1965).

The propagation of an electromagnetically driven shock wave is discussed for the particular case of propagation perpendicular to an external magnetic field applied parallel to the driver field. Calculations are described for propagation in argon in the ambient pressure range 100 mtorr-1 torr. The main result of these calculations shows that the plasma achieves a greater flow velocity at the cost of a reduction in the plasma enthalpy. The "stagnation enthalpy" of the plasma is, however, essentially the same as that obtained in the absence of any applied magnetic field. Experimental flow velocities and magnetic field configurations are discussed with reference to the shock wave model predictions and are shown to be qualitatively consistent with that model. (auth)

7963 TWO-DIMENSIONAL ROTATIONAL FLOW IN MAGNETIC GAS DYNAMICS. Kosirenko, V. Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser., No. 5, 21-5(1965). (In Russian).

Inverse methods of classic gas dynamics are used to obtain equations describing the vortex motion of a conducting gas along the equipotentials of an electric field in two-dimensional magnetogasdynamics. The orthogonality of the gas-velocity and the electric-current vectors in a magnetic field for the irrotational motion of an incompressible inviscid fluid is shown. (M.J.T.)

7964 THE RELATIVISTIC BOLTZMANN EQUATION. PART I. Abonyi, Ivan (Lorand Eoetvoes Univ., Budapest). Magyar Fiz. Foly., 13: 367-80(1965). (In Hungarian).

Attempts reported for generalizing the Boltzmann equation, with which the particle distribution in gases can be determined in coordinate and in velocity space, are examined, specifically in collision-free cases. Radiation and pair-production processes of quantum electrodynamics are taken into account for relativistic energies. It is concluded that the generalizations proposed are fundamentally equivalent, differing only in the symbolism used. The properties of the Boltzmann equation with respect to Lorentz transformations and the transformation properties of the distribution function are also evaluated. (TCO)

7965 RADIATIVE SHOCK STRUCTURE. Koch, Paul A. (Columbia Univ., New York). Phys. Fluids, 8: 2140-7(Dec. 1965).

A study is made of plane gas dynamic and transverse magnetogasdynamic shock waves in fully ionized hydrogen at conditions such that radiative processes are significant. The length scale required for a radiative shock wave to be steady is large, and the establishment of a truly steady-state flow is found only for dimensions relevant to astrophysical cases. In the case of such an established flow the Rankine–Hugoniot jump equation (i.e., the relation between the flow variables in the initial and final states) is analyzed. It is shown that of the twelve roots of this equation only two are physical, corresponding to the super-signal initial and sub-signal final states. The differential equations which describe the above shock waves are analyzed for cases where the shock is optically thick, i.e., the mean free path for absorption of radiation is much smaller than the characteristic lengths for change of the flow variables. A new criterion is given for the validity of this approximation. (auth)

7966 ALFVEN WAVES IN AN INCOMPRESSIBLE MEDIUM. Hoult, David P. (Pennsylvania State Univ., University Park). Phys. Fluids, 8: 2240-4(Dec. 1965).

The theory of Alfvén wave propagation in an incompressible, inviscid, infinitely conducting medium is presented. The theory is presented in terms of canonical equations of motion. Topics included are the generation of arbitrary small amplitude waves, the propagation of finite amplitude waves on a nonuniform magnetic field, and the reflection of finite amplitude waves from an idealized surface of the sun. A nonlinear amplification process associated with reflection is discussed. (auth)

7967 THEORY OF COLD NEUTRON SCATTERING BY HYDROGEN IN LIQUID ARGON. Sears, V. F. (Univ. of Oxford, Eng.). Proc. Phys. Soc., 86: 965-72(Nov. 1965).

The velocity spectrum obtained previously is used in a calculation of the cold neutron scattering cross section for a dilute concentration of hydrogen in liquid argon. Since the theoretical cross section contains no unknown parameters, a comparison with recent observed cross sections provides a good test of the validity of the itinerant oscillator model of liquids. (auth)

7968 SHOCK-WAVE PARAMETERS IN A PARTIALLY IONIZED GAS. Kaplan, S. A.; Podstrigach, T. S. (Gorkii Scientific Research Inst. for Radiophysics, USSR). Soviet Astron. AJ (Engl. Transl.), 9: 438-41 (Nov.-Dec. 1965).

Translated from Astron. Zh., 42: 552-6(May-June 1965).

The structure of shock waves with radiative loss in a partially ionized gas was derived with an electronic computer and is presented graphically. Relations are established between the shock velocity and the maximum electron temperature, the widths of the front and the de-excitation region, and the final density. The effect of de-excitation of the shock parameters is considered. (auth)

7969 HYDROMAGNETIC WAVES IN A NONISENTROPIC MEDIUM IN THE PRESENCE OF A GRAVITATIONAL FIELD. Getling, A. V. (Shternberg State Astronomical Inst., USSR). Soviet Astron. AJ (Engl. Transl.), 9: 451-3(Nov.-Dec. 1965).

Translated from Astron. Zh., 42: 568-71(May-June 1965).

Dispersion relations are obtained for various types of waves. Their polarization and amplitude ratios are found. In the problem considered, in which compressibility is not taken into account, the wave vector and magnetic field have arbitrary directions. In the case of a compressible medium, a fixed direction is assigned to them. The problem of stability is discussed. (auth)

7970 ON THE TEMPERATURE OF THE SPARK DISCHARGE IN A LIQUID. Kutsenko, A. N.; Kortnev, A. V. (Odessa Polytechnic Inst.). Ukr. Fiz. Zh., 10: 1033-5 (Sept. 1965). (In Ukrainian).

Experimental data are given concerning the temperature and some other properties of spark discharges in water. The temperature of the plasma is calculated by means of an approximate equation obtained from a quasi-classical expression for the total exchange recombination intensity. The spark discharge temperature in high voltage condensed sparks in the air and in the region bounded by liquid was also determined using the intensities of the 5105.54 and 5153.24 Å lines. With a voltage of U = 25 kv, interelectrode distance of l = 1.5 cm, and battery capacitance C = 1.25 μf, the temperatures are $T \sim 1.5 \cdot 10^4$ K and $\sim 2 \cdot 10^4$ K, respectively. (ATD)

7971 PROPAGATION SOLUTIONS OF THE BOLTZMANN EQUATION. Skvortsov, G. E. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz., 49: 1248-60(Oct. 1965). (In Russian).

Plane wave solutions of the Boltzmann equation are discussed. The determination of such solutions is equivalent to setting up the spectrum of the corresponding operator. The spectrum is presented for the problem with initial data and for the stationary problem. A feature of it is the presence (along with the dispersion trajectories) of a continuous spectrum for which no relation between ω and k exists. The continuous spectrum is related to the strong degree of nonequilibriumness of the process. The theory is applied to the propagation of ultrasound in a gas. (auth)

7972 THE ABSOLUTE STABILITY OF SOME PLANE-PARALLEL FLOWS AT LARGE REYNOLDS NUMBERS. Iordanskii, S. V.; Kulikovskii, A. G. (Inst. of Mathematics, Academy of Sciences, USSR). Zh. Eksp. Teor. Fiz., 49: 1326-31(Oct. 1965). (In Russian).

Localized disturbances in the plane-parallel flow of a viscous fluid are considered. It is shown that localized disturbances decay after a certain time in any finite region of the flow. The Reynolds numbers are assumed to be large and the wave numbers tend to zero on the corresponding branches of the neutral curves. (auth)

7973 EFFECT OF THE VISCOSITY ANISOTROPY ON A PLANE PARALLEL FLOW OF AN IONIZED MEDIUM IN A COPLANAR MAGNETIC FIELD. Sakhnovskii, E. G. Zh. Prikl. Mekh. Tekh. Fiz., No. 3, 11-18(May-June 1965). (In Russian).

The effect of the anisotropic viscosity coefficient on the flow of an ionized incompressible gas in a planar channel was investigated analytically. The degree of ionization is assumed to remain constant and the thermal conductivity coefficient is independent of temperature. The channel is infinite in the x- and y-directions and is bounded by the planes z = a and z = −a. The flow is assumed to be of Couette type and an expression is given for the anisotropic viscosity in the x-y plane. From the generalized Ohm's law j_z is shown to be zero. First, a solution is attempted for the stationary flow with and without pressure gradients. For s = 1 (fully ionized case) the solution is obtained for the velocity components in a pressure gradient field. The velocity field is found for the flow with constant pressure gradient. (ATD)

7974 HALL EFFECT IN AN ELECTRICALLY CONDUCTING FLUID IN A VARIABLE MAGNETIC FIELD AND AT LARGE MAGNETIC REYNOLDS NUMBERS. Kim, K. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 3, 35-8(May-June 1965). (In Russian).

The Hall effect on an electrically conducting fluid was studied analytically in a rectangular channel with insulated walls. A running wave applied magnetic field is used outside the channel, z = 0 and z = δ. An expression is obtained for the induced field and the solution is given after the manner of Galerkin. From this, equations were obtained for $a_{mn}(t)$ and $b_{mn}(t)$ and their values were computed numerically on a digital computer. The results show that by increasing R_M (magnetic Reynolds number) the zero- and double-frequency fields decrease, whereas the fundamental frequency field a_{31} increases. For small R_M the field distribution tends to be less symmetric. The case is also considered where the amplitude of the external magnetic field varies along the channel width. (ATD)

7975 MAGNETOHYDRODYNAMICS. Kulikovskiy, Andrey Gennadievich; Lyubimov, Grigoriy Aleksandrovich. Adiwes International Series in Physics. Reading, Mass., Addison-Wesley, 1965. 223p. $9.75.

Translation from the Russian by Scripta Technica, Inc., of Magnitnaya Gidrodinamika.

The results of recent research on the interaction of a conductive fluid with an electromagnetic field are considered primarily. The topics covered are the basic equations, motion of an incompressible fluid, and simple wave structures, small disturbances, and surfaces of discontinuity in an ideal gas. Also nonstationary and stationary motions of an ideal gas, stationary motion of a nonideal gas, and the flow of a conducting fluid past magnetized bodies are considered. (J.F.P.)

7976 RADIATIVE CONTRIBUTIONS TO ENERGY AND MOMENTUM TRANSPORT IN A GAS. Sampson, Douglas H. Interscience Tracts on Physics and Astronomy. New York, Interscience Publishers, 1965. 194p.

The determination of the radiative contributions to the energy and momentum transport equations for a gas for general conditions is considered. In deriving the basic equations the particle or photon approach is used. This brings out the strong similarity to the derivation of the matter contributions to the energy and momentum transport equations by taking the appropriate moments of the material particle Boltzmann equations. Some discussion of the effects of scattering and some of the aspects of radiative transport are treated, including the radiative contributions to momentum transport and the effect of the macroscopic motion of matter on the radiative contributions to energy transport. Also a discussion of some of the problems arising when the matter is not in local thermodynamic equilibrium and the conditions required for local thermodynamic equilibrium to exist is included. (J.F.P.)

7977 METHODS IN COMPUTATIONAL PHYSICS. VOLUME 4. APPLICATIONS IN HYDRODYNAMICS. Alder, Berni; Fernbach, Sidney; Rotenberg, Manuel (eds.). New York, Academic Press, 1965. 396p. $14.00.

The power and versatility of large digital computers in solving hydrodynamics problems are illustrated through

reports of their varied applications in the field. Atmospheric circulation, ocean circulation, shocks in rarefied media, molecular flow in a gas, molecular dynamics in a fluid, stability of boundary layers, propeller design, stellar evolution, and seismology are discussed regarding computer applications for studies in these fields. (J.F.P.)

7978 METHODS IN COMPUTATIONAL PHYSICS. VOLUME 3. FUNDAMENTAL METHODS IN HYDRODYNAMICS. Alder, Berni; Fernbach, Sidney; Rotenberg, Manuel (eds.). New York, Academic Press, 1964. 398p. $13.50.

Current techniques for numerically solving problems primarily in nonviscous, compressible fluid motion are considered. Methods using Lagrangian or Eulerian coordinates or both in several space dimensions, and the use of the same techniques along with the complexity of elastic-plastic media are given. The method of characteristics in one- and two-space dimensional problems and the particle-in-cell method are discussed. Also viscous incompressible fluid flow is included. (J.F.P.)

Geophysics

Refer also to abstracts 7254 and 7761.

7979 (AD-620996) DEVICE FOR MEASURING THE DENSITY AND MOBILITY OF IONS IN THE ATMOSPHERE. Bragin, Yu. A. Translated from Russian Patent No. 154066. May 31, 1962. 6p. (FTD-TT-65-207). CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf.

A device is described for measuring the density and mobility of ions in the atmosphere. The device contains a cylindrical intake attachment, two-screening sieve-shutters (placed at a given distance one from the other), a collector, an electrometer, and a radio transmitter. (M.O.W.)

7980 THE ARTIFICIAL RADIATION BELT. Pieper, G. F. (Johns Hopkins Univ., Silver Spring, Md.). APL Tech. Dig., 2: 3-7(Nov.-Dec. 1962).

The characteristics of the artificial radiation belt produced by the high-altitude explosion of July 9, 1962, are described. Electrons from fission-fragment beta decay were found to be the primary source of the belt. Data from radiation detectors, power-system degradation, and solar-cell damage of the satellites Ariel, Injun, Telstar, Transit 4B, and TRAAC were studied. Maps of the composite electron flux were constructed along several field lines and in a radial-distance and invariant-latitude coordinate system. The duration of the belt is discussed. A second lower-altitude, less intense belt was discovered from data of the TRAAC G-M counter. Its configuration, duration, maximum flux intensity and energy, and source are described. (M.J.T.)

7981 ON THE COULOMB RELAXATION PROCESS IN THE DISTRIBUTION OF FAST PARTICLES IN THE EARTH'S RADIATION BELTS. Timofeev, G. A. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeronomiya, 5: 754-6(July-Aug. 1965). (In Russian).

Changes occurring in the distribution of fast electrons or ions in the radiation belts of the earth as a result of Coulomb interaction with the medium were examined, using the kinetic equation as starting point. The Coulomb interaction of fast particles with cold plasma leads to small primary changes of the energy and momentum. The average time of subsequent collisions of particles within the belt is much shorter than the period of oscillation of the geomagnetic field; therefore, the collision integral was averaged according to the oscillation period. It was also assumed that the first adiabatic invariant of the motion is conserved. The kinetic equation was solved by computer calculations. The results indicated that from an initial distribution with a half-length of 50 km and an energy of about 200 kev, with a boundary condition for the height of electrons at 200 km, the collision frequency of electrons is greater than that at higher levels. Electrons reflected at heights of 350 and 500 km were found to diffuse rapidly, within 3×10^3 and 1×10^4 sec, into the denser layers of the atmosphere with hardly any energy loss. A noticeable portion of the electrons reflected at 750 km is lifted into less dense layers of the atmosphere. (TTT)

7982 EVENTS OF THE PENETRATION OF PARTICLES FROM THE OUTER RADIATION BELT OF THE EARTH INTO THE STRATOSPHERE. Charakhchian, A. N.; Golenkov, A. E.; Charakhchian, T. N. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Geomagn. Aeronomiya, 5: 757-9(July-Aug. 1965). (In Russian).

During the period from January to April 1964 a number of ionizing radiation events were recorded in the atmosphere over Murmansk, at a latitude of 64°N, but simultaneous measurements in the Antarctic region at a latitude of 77°S failed to reveal them. These events can not be attributed to solar flares but were probably caused by disturbances in the external radiation belt of the earth which caused the particles to penetrate the upper layer of the atmosphere to a height of 15 km. The wall thickness of the counters used in the measurements corresponded to the path of 250-kev electrons. Comparison with geophysical data indicated that these events may be correlated with the K indices of geomagnetic acitivity, with large ionospheric disturbances, and, in the region of auroras, with the absorption of radiowaves in the F2 layer of the ionosphere. It is postulated that the electrons leaving the radiation belt are absorbed in the atmosphere at pressures <1 g/cm^2, yielding penetrating bremsstrahlung photons which are detected by the instruments. (TTT)

7983 ON THE NATURE OF NEGATIVE DISTURBANCES OF HORIZONTAL COMPONENT OF GEOMAGNETIC FIELD IN HIGH LATITUDES. Afonina, R. G. Geomagn. Aeronomiya, 5: 772-4(July-Aug. 1965). (In Russian).

The aurora is closely correlated with magnetic disturbances in the polar regions. It was assumed that the oval-shaped region of the aurora is closest to the geomagnetic pole during day and farthest during the night. To confirm this assumption, the diurnal S_D variations of magnetic data were analyzed. At three latitudes, a correlation was found between the data and the frequency of daily variations of the aurora at the zenith; the maximum of the aurora was found to correspond with the S_D minimum of the H component. On this basis, the disturbances could be decomposed into positive and negative factors. Two branches of the flux were derived; the minimum of the disturbing horizontal vector $\Delta\bar{H}$ exhibited a strong dependence on the latitude. However, $\Delta\bar{H}$ may be more satisfactorily correlated with a closed circular flux which extends to all latitudes. It is concluded that the disturbances in the H component in the polar region are caused by a circular or oval-shaped flux that reaches into lower latitudes of about 65° during the local geomagnetic midnight and the highest latitudes during the local geomagnetic noon, assuming intermediate values during morning and evening. The daily variations of captured radiation, measured by the Injun-3 and Explorer-14 satellites, agree with the variation of the disturbances and the zones of polar auroras. (TTT)

7984 IONOSPHERIC EFFECTS OF NUCLEAR EXPLOSIONS: LOW ALTITUDE EXPLOSIONS. Saha, A. K.; Mahajan, K. K. (National Physical Lab., New Delhi). Indian J. Pure Appl. Phys., 3: 433-44(Nov. 1965).

The different types of ionospheric effects caused by nuclear explosions were observed using various types of equipment in routine operation following the 24 atmospheric nuclear explosions by the USSR over Novaya Zemlya in August–December 1962. It was found that only the D and F_2 regions of the ionosphere are affected. The D-region effects, which could be observed as enhancement of atmospheric noise levels at 27 and 100 kc/sec and as an increase of long wave field strength of Radio Tashkent (164 kc/sec) radiations, were found to start with delay times varying from a few minutes to 2 hr, while the F_2-region effects, which could be identified by f_0F_2 enhancement on C4 ionograms, were found to occur within 4 hr after the explosions. Both the D and F_2-region effects could be observed as ab-

sorption increases on cosmic radio noise records at 22.4 Mc/sec, the D-region effects coinciding with the low frequency effects and the F_2-layer effects with the f_0F_2 enhancement. The F_2-layer effects on cosmic radio noise absorption were noted only for the cases for which post-detonation f_0F_2 was above 10 Mc/sec. From the nature of the observed D-region effects it was possible to conclude that the ionization enhancement in the case of a nuclear detonation is more localized to heights lower than the effective height of radio noise absorption in the case of a sudden ionospheric disturbance (SID) caused by a solar flare. An analysis made with true heights obtained from C4 ionograms for several explosion cases showed that there is enhancement of electron density at all levels above 200 km. The maximum effect in the F_2 layer was found to occur somewhat below the F_2 peak. Comparison of the observed F-layer cosmic radio noise absorption with values calculated with the help of electron density profiles deduced from ionograms, led to the conclusion that there is considerable increase in ionization on the topside of the ionosphere as well. Velocity computations for the F-layer disturbance phenomenon made with the data collected at Delhi as well as with the f_0F_2 data reported from 28 widely separated ionospheric stations gave an average speed of 550 m/sec, which was somewhat lower than the acoustic velocity for the F region expected from available atmospheric models. Probable mechanisms of propagation of both the D- and F-region disturbances are discussed. Certain features in the observed effects, which may be relevant in formulating procedures for atmospheric nuclear tests detection, are pointed out. (auth)

7985 ON ANALYSIS OF THE SECULAR VARIATION. I. A HYDROMAGNETIC CONSTRAINT: THEORY. Roberts, P. H. (Univ., Newcastle-upon-Tyne, Eng.); Scott, S. J. Geomagnet. Geoelec., 17: 137-51(1965).

It is noted that the time-scale of the secular variation of the geomagnetic field is rather short compared with the electromagnetic diffusion times appropriate to the earth's core. It is therefore suggested that the secular variation is primarily due to the rearrangement of pre-existing lines of force emanating from the core, and not due to the creation of new (or destruction of old) flux tubes by electromagnetic diffusion. The theoretical consequences of this idea are fully examined. (auth)

7986 CONVERGENCY OF THE SPHERICAL HARMONIC COEFFICIENTS OF THE GEOMAGNETIC FIELD. Nagata, Takesi (Tokyo Univ.). J. Geomagnet. Geoelec., 17: 153-5(1965).

It is shown theoretically that the geomagnetic field consists of the main component consisting of spherical harmonics of lower degree ($n \leqq 8$) that originate within the earth's core and noise-like components whose sources are located in the uppermost part of the earth. (L.B.S.)

7987 THE GEOMAGNETIC EFFECTS OF THE JOHNSTON ISLAND NUCLEAR EXPLOSION OF JULY 9, 1962 AT QUETTA. Kazmi, S. A. A. (Geophysical Inst., Quetta, Pakistan). J. Geomagnet. Geoelec., 17: 161-2 (1965).

The geomagnetic disturbances and ionospheric changes resulting from a 1.4 megaton high altitude nuclear explosion are reported. It is suggested that the initial disturbances propagated electromagnetically and the subsequent main field changes at Quetta were caused by the arrival of hydromagnetic waves from the detonation site. (L.B.S.)

7988 TRAPPED ELECTRON COMPONENT FROM ORBITING REACTOR NEUTRON DECAY. Carpenter, D. G. (U. S. Air Force Academy, Colo.); Cohen, D. A. J. Geophys. Res., 70: 5831-8(Dec. 1, 1965).

A 1-megawatt reactor satellite is assumed to be in a 1000-km circular, geoequatorial orbit. The average steady-state omnidirectional trapped electron flux due to β decay from leakage reactor neutrons is calculated to be of the order of 10^6 electrons cm^{-2} sec^{-1} in the L-shell region intercepted by the orbit ($1.11 < L < 1.28$). The average mean lifetime is estimated to be 150 days, and approximately 1 year is required to reach steady-state conditions. (auth)

7989 ION DISTRIBUTION AND TEMPERATURE IN THE TOPSIDE IONOSPHERE OBTAINED FROM THE ALOUETTE SATELLITE. Watt, Theodore M. (Stanford Univ., Calif.). J. Geophys. Res., 70: 5849-59(Dec. 1, 1965).

Electron-density distributions are obtained from Alouette topside soundings recorded at Stanford University. Plasma scale height profiles are then determined, from which information can be deduced about relative ion concentrations, electron temperature, and ion temperature. Results are obtained for dip latitudes between 48 and 78°N, and altitudes from 400 to 900 km. The lower-latitude nighttime data can be interpreted in terms of a three constituent (O^+, He^+, H^+) diffusive equilibrium model with an $(O^+)-(He^+, H^+)$ transition occurring at about 550 km in the summer and 500 km in the winter. The variation of the transition altitude with local time and with latitude is obtained. The transition level is found to rise with increasing latitude, rising above 900 km at about 62° dip latitude. It is also observed to rise very quickly at local sunrise and to descend quickly at local sunset. The data suggest that the $(O^+)-(He^+, H^+)$ transition is at least as high as 1000 km during the day. Under these conditions the daytime scale heights at all observed latitudes and the nighttime scale heights at dip latitudes north of 63° can be interpreted in terms of temperature variations in an O^+ ionosphere. (auth)

7990 ADVANCES IN PARTICLES AND FIELD RESEARCH IN THE SATELLITE ERA. Hess, W. N.; Mead, G. D.; Nakada, M. P. (Goddard Space Flight Center, Greenbelt, Md.). Rev. Geophys., 3: 521-70(Nov. 1965).

A survey of the more important results from investigations of energetic particle radiations, plasmas, and magnetic fields in space is presented. One of the highlights of these investigations was the discovery and study of the continuous flow of plasma away from the sun, the so-called solar wind. This plasma flow confines the earth's magnetic field within about 10 R_E on the day side and is responsible for the magnetospheric tail, which is thought to extend beyond the orbit of the moon. Inside this cavity, large fluxes of magnetically confined energetic charged particles were discovered. Confinement lifetimes in the tail have not yet been established; however, out to roughly 8 R_E the particles are trapped and constitute the Van Allen radiation belt. The study of the solar cosmic rays that accompany some solar flares is enhancing the understanding of solar processes and of the interplanetary medium through which the solar protons travel. Continued investigations of cosmic rays are leading to a better knowledge of the heavy particle component, of the low-energy end (below 100 Mev) of the spectrum, and of the processes responsible for Forbush decreases. On the basis of these discoveries, a new picture is emerging of our environment and, more generally, of the processes in the solar system. (auth)

7991 ELECTROMAGNETIC ASPECTS OF HYPERSONIC FLIGHT. Second Symposium on the Plasma Sheath, Its Effect upon Reentry Communication and Detection, held in Boston, Mass., April 10, 11, and 12, 1962. Rotman, Walter; Moore, Howard K.; Papa, Robert (eds.). Baltimore, Md., Spartan Books, Inc., 1964. 378p. (CONF-620406).

The electric properties of ionized flow fields and the effects of contaminants in changing the plasma parameters are considered. These studies provide an estimate of the effects of ablative materials in changing electron concentration, and of coolants and electrophilic compounds in enhancing signal transmission through the plasma sheath. The radiation characteristics of plasma-covered antennas are treated. Although estimates of signal attenuation during re-entry have usually been based on the idealized assumption of a plane wave incident upon a semi-infinite slab of plasma, this does not adequately describe the changes in the radiation patterns of a small aperture antenna on a

complex aerospace vehicle. Other topics considered are diagnostic techniques for flow-field studies, re-entry radar cross section, effects of static magnetic fields, and voltage breakdown of antennas at high altitudes. The diagnostic techniques include instrumentation for hypersonic shock and wind tunnels, for ballistic ranges, and for missile flight tests. (J.F.P.)

Gravitation, Quantum Mechanics, and Relativity Theory

Refer also to abstract 7700.

7992 (CNAEM–29) WIGNER'S METHOD IN QUANTUM STATISTICAL MECHANICS. Imre, Kaya; Oezizmir, Ercuement; Zweifel, P. F. (Cekmec Nuclear Research Center, Atomic Energy Commission, Istanbul (Turkey)). Oct. 1965. 36p. Dep. mn.

The Wigner method of transforming the quantum mechanical operators into their phase-space analogues is reviewed with applications to the scattering theory, equilibrium and dynamical state of the many particle systems. Inclusion of exchange effects is discussed. (auth)

7993 (JINR-P–2307) O POLNYKH NABORAKH NABLYUDAEMYKH. (On Complete Set of Observables). Smorodinskii, Ya. A.; Tugov, I. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 14p. Dep. mn.

Possible complete sets of commuting operators are investigated in nonrelativistic quantum mechanics. The example of the discrete and continuous spectra of the Coulomb interaction is considered. (auth)

7994 (JINR-P–2421) URAVNENIYA KVANTOVOI ELEKTRODINAMIKI. (Equations of Quantum Electrodynamics). Polubarinov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 74p. Dep. mn.

The basic formulations of quantum electrodynamics are reviewed from a unique point of view. A complete analysis of electrodynamics with transverse gauge of state vectors (Fermi-Gupta formulation) is given, which is most convenient and widely in use now. (auth)

7995 (JINR-P–2422) OBOSNOVANNOST SPETSIALNOI TEORII OTNOSITELNOSTI OPYTAMI V OBLASTI FIZIKI VYSOKIKH ENERGII. (Proof of Special Relativity Theory by High Energy Physics Experiments). Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 22p. Dep. mn.

An analysis is given of the verification of the basic principles of relativity theory in the domain of high-energy physics. The theoretical bases for the proof of special relativity in the region of high energies and small scales are reviewed, for the case of internal four-dimensional time vector, n, where n is associated with the matter of the interacting elementary particles and the case of external n, where n is associated with the physical vacuum. Consideration is given to the proofs of microcausality, of the asymptotic relations between cross sections, and the homogeneity and isotropy of space-time. (M.J.T.)

7996 PROPERTIES OF WAVE PACKETS OF VARIABLE AMPLITUDE. Crosignani, B.; Engelmann, F.; Zampaglione, V. (Euratom-CNEN, Frascati, Italy). Nuovo Cimento (10), 40A: 150-8(Nov. 1, 1965).

The properties of single wave packets of arbitrary width of the spectrum, in a homogeneous medium with a specified dispersion relation, are investigated. Especially, if the source of the excitation is localized (boundary value problem), the principle of causality may be used to determine the direction of propagation of the wave packets. A criterion for its amplification or evanescence then can be simply formulated. In the case of wave packets representing the evolution of a perturbation imposed at a certain instant (initial value problem), where the problem of stability arises, Sturrock's criterion for the convectivity of an instability is generalized to apply even if the packet is not almost monochromatic. The implicit assumptions about the initial or boundary condition which are contained in considering a simple mode, are displayed. (auth)

7997 REMARKS ON THE QUANTUM KINEMATICS OF THE ANGULAR MOMENTUM OF A PARTICLE. Levy-Leblond, J.-M. (Laboratoire de Physique Theorique, Orsay, France). Nuovo Cimento (10), 40A: 748-55(Dec. 1, 1965).

The probability that the total angular momentum of a particle, well defined in a certain system of reference, takes a certain value in a translated system is calculated. Moses and Wang pointed out the physical interest of the problem but used complicated methods of calculation, not permitting them to obtain exact results. Simple and exact analytical expressions are obtained for these probabilities in terms of sums of squares of spherical Bessel functions, using a completely natural method. The method is applicable in a general manner to all problems related to the kinematics of the total angular momentum of a system. (tr-auth)

7998 INTEGRATION OF THE SCHROEDINGER EQUATION BY A MONTE CARLO METHOD. Thouless, D. J. (Cambridge Univ., Eng.). Proc. Phys. Soc., 86: 905-13(Nov. 1965).

A problem suggested by the study of exchange in solid helium is set up; this is the problem of calculating the exchange energy of two identical spherical particles enclosed in a box. The eigenfunction of a six-dimensional wave equation must be calculated in a region in which it is very small. The calculation is carried out by a random walk method. (auth)

7999 ADVANCED QUANTUM THEORY. An Outline of the Fundamental Ideas. Roman, Paul. Addison-Wesley Series in Advanced Physics. Reading, Mass., Addison-Wesley Publishing Co., Inc., 1965. 746p. $17.50.

The framework of quantum theory, collision theory and related topics, and symmetry and invariance in quantum theory are covered. Special attention is given to quantized fields, although relativistic quantum field theory is omitted. Relativistic quantum mechanics and symmetry problems are included. Collision theory is explored from different approaches, including the elements of dispersion relation techniques. (J.F.P.)

8000 THE STRUCTURE OF RADIATION FROM BOUNDED SOURCES IN ASYMPTOTICALLY FLAT SPACE [Thesis]. Morgan, Thomas Anthony. Syracuse, N. Y., Syracuse Univ., 1965. 66p.

An introduction to the initial value problem for null hyperplanes and light cones is presented. The initial data for the general massless Pauli-Fierz fields is found for these null hypersurfaces. The two-component neutrino field, the electromagnetic field, and the linear gravitational field are special cases of the general Pauli-Fierz field. The Peeling theorem for the electromagnetic field is generalized to the Peeling theorem for the general Pauli-Fierz field. That is, the asymptotic structure of the general massless Pauli-Fierz field with bounded sources is determined. It is found that some components of the Pauli-Fierz field with spin s behave asymptotically as $1/R^{2s}$. The connection between this asymptotic behavior of the Pauli-Fierz fields and the initial value problem for a light cone is exhibited. The work of Bondi and Sachs, which considered the asymptotic behavior of a gravitational field with bounded sources, is extended to include the effects of electromagnetic and two-component neutrino radiation from the sources. It is found that these two fields also peel in an asymptotically flat space and their peeling implies that the asymptotic gravitational field coupled to them has the same asymptotic structure as was found by Bondi and Sachs for the vacuum case. (Dissertation Abstr.)

8001 GEOMETRICAL PROPERTIES OF THE SCHWARZSCHILD FIELD [Thesis]. Rodgers, William

Calhoun. Chapel Hill, N. C., Univ. of North Carolina, 1964. 165p.

The question of multi-valuedness of geodesics in the Schwarzschild field solution in classical general relativity theory is considered. The basic goal was to obtain information about the caustic surface relative to a given point in the field. The geodetic trajectories of particles moving in this field were studied. A complete classification of all geodesic motion in this field (time-like, null and space-like intervals are all considered) is given as well as all the integrated solutions. The spatial spherical symmetry of the field allows the basic problem to be considered in a 3-dimensional coordinate system (3M system), which consists of one time and two space coordinates. In this space, the caustic surface is found to consist of two essentially different parts. One part, a plane which is coincident with the symmetry axis and parallel to the time axis, is entirely due to the spherical symmetry of the field. The other part (off the symmetry axis in general) arises directly from the curvature of the space. General equations are given, which may be used to compute conjugate points relative to a given point along any geodesic in the field. Some geodetic trajectories are found to contain no conjugate points except possibly the ones on the symmetry axis. For quantitative answers as to the nature of the caustic surface numerical procedures must be used. Suitable numerical methods are discussed and applied by way of illustration. Work was also done in two closely related areas. Chapter V describes a representative scale model of the light cone in the Schwarzschild 3M space, which was constructed. Chapter IV gives in tabular form pertinent data on quasi-elliptic, parabolic and hyperbolic orbits. For the first of these, the magnitude of the advance of the perihelion and coordinate and proper time periods were given; for the others, total angles of flight were given. (Dissertation Abstr.)

Low Temperature Physics

Refer also to abstracts 7597 and 8310.

8002 (COO-1198-299) ATTEMPTS TO DETECT SUPERFLUDITY IN ^{3}He. Wheatley, J. C. (Illinois Univ., Urbana). [1965]. Contract AT(11-1)-1198. 21p. (CONF-650824-2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Symposium on Liquid Helium, St. Andrews, Scotland.

The presumed characteristics of superfluid ^{3}He, used as guides in the design of experiments intended to detect ^{3}He superfluidity, are described. Experimental searches for this superfluid state are also reviewed. (T.F.H.)

8003 (MIT-3226-8) THE RELATION OF STRUCTURAL DEFECTS AND MICROSTRUCTURE TO SUPERCONDUCTIVITY. Final Report, May 15, 1963-August 15, 1965. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-3226. 109p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Three separate papers are included. They are: the effect of processing history on the superconducting properties and long range order of Ta_3Sn, precipitation in aluminum alloys; Al-15% Zn, and the magnetic field distribution in a Type II superconductor. Variations of the transition temperature and long range order parameter of Ta_3Sn compacts were studied as functions of sintering time and temperature. Magnetization, transition temperature, and residual resistivity measurements were made on an Al-15% Zn alloy (atomic) aged at 220 and 200°C. The magnetic field distribution in the gap between half-ellipsoids of niobium was measured with a thin-film bismuth probe, for applied fields of up to 7 k Oersteds. (M.O.W.)

8004 FLUX CREEP AS A DOMINANT SOURCE OF DEGRADATION IN SUPERCONDUCTING SOLENOIDS. Iwasa, Y.; Montgomery, D. Bruce (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Lett., 7: 231-3(Nov. 1, 1965).

Experimental evidence is reported that the mechanism of unstable flux creeping arising from thermal instabilities is responsible for the current degradation commonly observed in superconducting solenoids. Transient flux creeping was induced in a sample of 50-ft. of noninductively wound Nb-25%-Zr wire by means of suitable magnetic field pulses. Typical data are shown for 125-μsec and 20-μsec rise time pulses, and the features exhibited by the data are discussed. (L.B.S.)

8005 MAGNETIZATION OF A CYLINDRICAL HARD SUPERCONDUCTOR. Hulbert, J. A. (Royal Radar Establishment, Malvern, Eng.). Brit. J. Appl. Phys., 16: 1657-66(Nov. 1965).

The Kim-Anderson model of flux pinning in a hard superconductor is used to compute the magnetization of a cylindrical sample for a number of typical magnetization paths. Experimental magnetization cycles for a ternary lead alloy in different states of anneal are compared with the computation and the possible significance of the exhibited deviations is discussed. (auth)

8006 DETERMINATION OF THE CRITICAL TEMPERATURE OF A SUPERCONDUCTOR WITH ELECTRIC ADMIXTURE. Moskalenko, V. A.; Palistrant, M. E. (Moscow State Univ.; Inst. of Mathematics, Academy of Science, Moldavian SSR). Dokl. Akad. Nauk SSSR, 162: 539-42(May 21, 1965). (In Russian).

With the use of the single-zone model of Bardeen, Cooper and Schrieffer it is shown that an electrical impurity has no noticeable effect on the critical temperature T_c of a superconductor. However, with a two-zone model the electrical impurity has a substantial effect on T_c due to intrazonal scattering on the electrical impurity. At low concentrations of electrical impurity it is found that the critical temperature decreases linearly with increasing impurity. At high concentrations of impurity the critical concentration of impurity at which $T_c = 0$ is observed only under the condition $\alpha^2 = 1$. Here α is the spin variable. (TTT)

8007 EFFECT OF TENSILE STRESS ON THE TRANSITION TEMPERATURE AND CURRENT-CARRYING CAPACITY OF Nb_3Sn. Buehler, E.; Levinstein, H. J. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 36: 3856-60(Dec. 1965).

The effect of a uniaxial tensile stress on the superconducting properties of a Nb_3Sn-cored wire was measured. The critical temperatures based on the midpoint of the resistance-temperature curves, decrease with increasing applied stress for a niobium-sheathed wire, while the critical temperature first increases and then decreases for a Monel-niobium-sheathed wire. In the Monel-sheathed wire, the initial increase in critical temperature is probably due to the fact that the Nb_3Sn is under compression. The current-carrying capacities of both types of wire first increase, then decrease on application of stress. As much as 10% of the zero-stress critical-current value can be lost under tension and still be recovered on unloading. (auth)

8008 NONIDEAL BEHAVIOR OF INHOMOGENEOUS SUPERCONDUCTING ALLOYS. Joiner, W. C. H. (Westinghouse Electric Corp., Baltimore). J. Appl. Phys., 36: 3895-3908(Dec. 1965).

An investigation of nonideal superconducting properties of inhomogeneous tin alloys reveals that the behavior of such samples represents a diverse set of phenomena intimately related to the nature of the inhomogeneities. Resistive temperature and field transitions are presented along with critical field data, magnetization curves, and remnant moment measurements. Several inhomogeneous samples are shown to possess very unstable magnetization curves and to show flux penetration at fields less than the bulk critical value. Annealing can make the magnetization more or less ideal, or produce very little change, depending on the nature of the inhomogeneity and the way it is altered in the process. Annealing sharpens the resistive transition temperature curve when more impurity goes into solution. It also can produce a large change in the apparent transition temperature. Samples examined

represent both positive and negative surface energy materials containing either predominantly normal state or superconducting state inhomogeneities, or a combination of both. Although negative surface energy materials show more hysteresis than positive surface energy materials under equivalent conditions, the nature of the inhomogeneity and its role in flux retention is more important than the simple difference between positive and negative surface energy. A detailed description of the behavior of each sample and speculations as to the origins of features not heretofore reported are included. (auth)

8009 LONGITUDINAL AND TRANSVERSE VOLTAGES IN SUPERCONDUCTORS. van Vijfeijken, A. G.; Niessen, A. K. Philips Res. Rep. 20: 505-27(Oct. 1965).

Both in the intermediate state and in the mixed state of superconductors resistivity and Hall effect can be observed. A model for the transverse and longitudinal voltages across a sample as a function of the applied magnetic field is discussed. Both voltages are related to the motion of normal regions or vortices. The forces acting on a vortex are also discussed. The present calculations result in the introduction of a Magnus-type force, the magnitude of which depends, among other factors, on the purity of the material. The predicted Hall angle in the mixed state as a function of the applied magnetic field is somewhat larger than the extrapolated value of the normal state. A comparison of this theory with experimental results is made. (auth)

8010 THE EXISTENCE OF LOWER TEMPERATURE LIMIT FOR SUPERCONDUCTIVITY IN SEMICONDUCTOR FILMS. Tavger, B. A.; Kogan, V. G. (Gorkii State Univ., USSR). Phys. Lett., 19: 353-4(Nov. 15, 1965).

The lowest temperature at which the energy gap exists in a semiconductor is determined. It is shown that this temperature may differ from zero. The square-law dispersion semiconductor film is considered within the above temperature range. In deriving the energy gap equation the interaction constant is assumed to differ from zero within the energy range of about $\hbar\omega_c$. A rough estimate is also given for the value of upper critical temperature limit. (J.F.P.)

8011 PROPAGATION OF MIXED STATE PHASE BOUNDARY IN TYPE-II SUPERCONDUCTOR. Boyd, R. G. (Univ. of California, Berkeley). Phys. Lett., 19: 374-5 (Nov. 15, 1965).

An expression is derived for the velocity of the magnetic field penetration of thick slab type-II superconductors. The velocity is found to be independent of resistivity in the dirty limit, in contrast to propagation velocities in normal metal. The equivalent equations for a thick-walled cylinder could not be solved, but the derived expression for velocity gives the correct order of magnitude for the experimental results on Nb 25% Zr. Also the fact that phase velocities in the experiment depended only weakly on resistivity is taken into account. (J.F.P.)

8012 COMMENT ON LITTLE'S MODEL SUPERCONDUCTING POLYMER. McCubbin, W. L. (Welsh Coll. of Advanced Technology, Cardiff, Wales). Phys. Lett., 19: 461-2(Dec. 1, 1965).

It is pointed out that the suggestion concerning superconductivity in polymers by Little (Phys. Rev. 134 1416 (1964)) is unjustified. It is shown that the criterion for superconductivity can not be satisfied. (J.F.P.)

8013 AMPLITUDE EFFECTS OF THE ALTERNATING FIELD SUSCEPTIBILITY OF SUPERCONDUCTING TANTALUM. Van Engelen, P. P. J.; Bots, G. J. C.; Blaisse, B. S. (Laboratorium voor Technische Natuurkunde, Delft, Holland). Phys. Lett., 19: 465-7(Dec. 1, 1965).

The alternating field susceptibility of superconducting tantalum is investigated. Two samples of high purity were used, each in the form of a wire one of which was annealed and the other unannealed. The experimental results for each sample are shown. The results for the annealed sample, at the same frequency and temperature in an increasing magnetic field, showed a pronounced hysteresis effect in contrast to the unannealed sample. (J.F.P.)

8014 SUPERCONDUCTIVITY OF VANADIUM. Martin, R. B.; Rose-Innes, A. C. (Manchester Coll. of Science and Tech., Eng.). Phys. Lett., 19: 467-9(Dec. 1, 1965).

Magnetization measurements were made at low temperature on a fairly pure sample of vanadium. The results indicate directly that vanadium is an intrinsic type-2 superconductor with a value of the Ginzburg-Landau parameter which is higher than that of niobium. Values of this parameter obtained by two different methods are given for various temperatures. The magnetization curve and the critical fields for vanadium are also shown. (J.F.P.)

8015 SUPERCONDUCTIVITY OF NbC/NbN WHISKERS. Darnell, F. J.; Bierstedt, P. E.; Forshey, W. O.; Waring, R. K. Jr. (E. I. du Pont de Nemours and Co., Wilmington, Del.). Phys. Rev., 140: A1581-5(Nov. 29, 1965).

Magnetic and electrical transport properties were studied on whiskers and platelets of NbC, NbN, and NbC/NbN in the superconducting state. Whiskers in the 2- to 100-μ diameter range show type-II superconducting behavior with $H_{c1} \sim$ 100 Oe and $H_{c2} \sim 110$ kOe. The critical current density in zero field was found unexpectedly to vary with diameter as $j_c \sim d^{-1.4}$. Such a dependence is not predicted by any simple model of transport-current distribution. Flux-creep phenomena were observed only in a narrow region of current-magnetic field variables; this is believed related to the crystal perfection of the compound whiskers. (auth)

8016 SOLUBILITY OF ^{3}He IN LIQUID ^{4}He AT 0 deg K. Edwards, D. O.; Brewer, D. F.; Seligman, P.; Skertic, M.; Yaqub, M. (Ohio State Univ., Columbus). Phys. Rev. Lett., 15: 773-5(Nov. 15, 1965).

A sensitive method for determining the binding energy of a small concentration of helium-3, which depends on measurements of the phase-separation temperatures of dilute solutions of known concentration, was used. The heat capacity of the solutions under their saturated vapor pressure was measured down to temperatures of about 0.1°K or less. The solutions were contained in a nylon calorimeter packed with small crystals of cerium magnesium nitrate used as a refrigerant and as a thermometer. The phase separation appears as a discontinuity in the specific heat, as is shown in the plot of specific heat of dilute solutions of helium-3 in helium-4 under their own vapor pressure. Such discontinuities were found in solutions with concentrations of 0.08, 0.10, 0.12, and 0.15, but not with concentrations of 0.04, 0.06, or 0.07. The failure to observe discontinuities in the specific heat for low concentrations can be interpreted in two ways; either the phase-separation line was not crossed or the discontinuities were too small to be noticed. The results for the heat capacities also show that the Landau-Pomeranchuk theory is applicable to these solutions. (J.F.P.)

8017 SUPERCONDUCTIVITY OF PROTACTINIUM. Fowler, R. D.; Matthias, B. T.; Asprey, L. B.; Hill, H. H.; Lindsay, J. D. G.; Olsen, C. E.; White, R. W. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 15: 860-2 (Nov. 29, 1965).

Superconductivity in protactinium metal below 1.4°K is reported. The superconducting transition of protactinium is shown, which was measured in a liquid helium-3 cryostat using the a-c method with the sample and detection coil immersed in the bath. Curves of thorium and uranium, measured in an identical manner are also shown. From a comparison of these curves it is suggested that the mechanism responsible for superconductivity in protactinium and in uranium is different from that in thorium, and that it is likely that the same mechanism is responsible for the superconductivities of protactinium and for that of uranium. Thus thorium, and not protactinium, would be the last of the actinide elements subject to valence electrons and structure considerations. (J.F.P.)

8018 MIXED-STATE PARAMAGNETISM IN HIGH-FIELD TYPE-II SUPERCONDUCTORS. Hake, R. R.

(North American Aviation Science Center, Thousand Oaks, Calif.). Phys. Rev. Lett., 15: 865-8(Nov. 29, 1965).

Measurements of the magnetization versus applied magnetic field of quasireversible, extreme type-II superconductors with Ginzburg-Landau-Abriksosov-Gor'kov κ values in the range 30 to 100 are reported. The data suggest that the high-field mixed-state behavior of such materials is characterized by a net paramagnetism and a Pauli-paramagnetic conduction-electron spin alignment which is comparable to that in the high-field normal state. Typical high-κ magnetization curves are shown for a well-annealed, homogeneous bcc solid-solution alloy specimen, Ti–16 at. % Mo, for which the data were obtained in a standard manner. Isothermal magnetization versus applied magnetic field for the same well-annealed specimen, and also various critical fields for this specimen are shown. (J.F.P.)

8019 DOES FERMI LIQUID THEORY APPLY TO ^{3}He? Anderson, P. W. (Bell Telephone Labs., Murray Hill, N. J.). Physics, 2: 1-3(Sept. 1965).

Examination of the experimental data on the low-temperature specific heat of liquid ^{3}He indicates that there is no evidence for the linear form expected on the Fermi liquid theory, and considerable evidence for the form T ln T. (auth)

8020 EXCHANGE IN SOLID ^{3}He AND THE HEISENBERG HAMILTONIAN. Thouless, D. J. (Cambridge Univ., Eng.). Proc. Phys. Soc., 86: 893-904(Nov. 1965).

The nuclear spins in solid ^{3}He are coupled to one another as a result of the Pauli exclusion principle. The exchange energy is so small that the Pauli principle can be treated rigorously as a boundary perturbation, and the coupling of the spins is given correctly by the Heisenberg hamiltonian. The coupling is antiferromagnetic in sign if, as is to be expected, two-particle exchange predominates, but may be ferromagnetic if three-particle exchange is more important. Only if four or more neighboring particles can change places simultaneously must a more complicated form of the Heisenberg hamiltonian be used. Herring's formula for the exchange energy is generalized to include exchange induced transitions between nearly degenerate levels of the system (spin-lattice coupling). It is demonstrated that coupling between the spin system and the lattice can be calculated if the exchange frequency is known as a function of strain, and a rough argument is given to show how different components of the strain tensor may affect this frequency. Temperature dependence of the exchange frequency is discussed. It is shown that at moderate temperatures thermally excited vacancies produce a new mechanism for spin exchange, which may work towards parallel alignment of the spins in the body-centered phase, but towards anti-parallel alignment in the hexagonal phase. (auth)

8021 SUPERCONDUCTING TRANSITION TEMPERATURES OF $ZrMo_2$, HfV_2 AND $PbAu_2$. Sadagopan, V.; Pollard, E.; Gatos, H. C. (Massachusetts Inst. of Tech., Cambridge). Solid State Commun., 3: 97-8(May 1965).

Three cubic C15-type compounds $ZrMo_2$, HfV_2 and $PbAu_2$ were found to be superconductors with transition temperatures 4.75°, 9.57° and 7.12°K, respectively. (auth)

8022 PHONON DENSITY STATES IN LEAD. Gilat, G. (Oak Ridge National Lab., Tenn.). Solid State Commun., 3: 101-3(May 1965).

The phonon density of states function for lead was calculated by a new sampling method from data of coherent scattering of slow neutrons. This function is correlated to the tunneling conductance data of superconducting lead. (auth)

8023 VORTEX NUCLEATION IN TYPE II SUPERCONDUCTORS. de Gennes, P. G. (Faculte des Sciences, Orsay, France). Solid State Commun., 3: 127-30(June 1965).

The barrier field H_S above which vortices can enter in a type II superconductor is derived from the Landau-Ginzburg equations in the limit $\kappa \gg 1$. For a macroscopic superconductor with a plane surface $H_S = H_c$ exactly, in agreement with experiment. For thin films in parallel fields, the results are very different. (auth)

8024 ANOMALOUS PENETRATION DEPTHS FOR SUPERCONDUCTORS COATED WITH NORMAL METALS. De Gennes, P. G.; Matricon, J. (Faculte des Sciences, Orsay, France). Solid State Commun., 3: 151-3(July 1965).

It is predicted that the penetration depth λ of a superconducting metal S is strongly field-dependent when the following conditions are simultaneously fulfilled: S is coated with a normal metal layer N, the temperature is in the Landau-Ginzburg region, and the field is close to the critical field H_c. This differs strikingly from the more familiar case where S is not coated, and λ is only weakly field-dependent. (auth)

8025 THE SPECIFIC HEAT JUMP IN SUPERCONDUCTORS. Melik-Barkhudarov, T. K. Soviet Phys.-Solid State (Engl. Transl.), 7: 1103-7(Nov. 1965).

Translated from Fiz. Tverd. Tela, 7: 1368-74(May 1965).

The character of the singularity in the electronic specific heat in the vicinity of the transition of an electron–phonon system from the superconducting into the normal state is discussed without assuming weak coupling. It is shown that with a picture of the transition region where the damping of the excitations is of the order of the energy gap, there is practically no effect. A value of the jump in the electronic specific heat at the transition temperature is found, and turns out to be less than the corresponding result of the theory of Bardeen, Cooper, and Schrieffer. (auth)

8026 POSSIBILITY OF CREATING A SUPERCONDUCTING STATE IN UNDOPED SEMICONDUCTORS BY ILLUMINATION WITH A POWERFUL LASER. Selivanenko, A. S. (Lebedev Inst. of Physics, Moscow). Soviet Phys.-Solid State (Engl. Transl.), 7: 1263-4(Nov. 1965).

Translated from Fiz. Tverd, Tela, 7: 1567-8(May 1965).

It is pointed out that in principle it is possible to create superconductivity in pure undoped semiconductors from the group for which a superconducting state has already been observed. The shape of the band in these semiconductors promotes the formation of a superconducting state, and the necessary carrier concentrations can be created by illuminating the semiconductor with a laser. (J.F.P.)

8027 ON THE STATIC CHARACTERISTICS OF CRYOTRONS. Artemenko, I. A.; Kan, Y. S., Rabukhin, L. B. (Inst. of Cybernetics, Academy of Sciences, Kiev). Ukr. Fiz. Zh., 10: 1035-6(Sept. 1965). (In Ukrainian).

The results of the experimental determination of transfer characteristics of a thin unscreened cruciform cryotron are presented. Curves for the valve current versus control grid current were obtained following the usual potentiometric method during a constant 10^{-6} v voltage across the valve, and by the current method of small resistance measurements with a constant minimum resistance of $R_{min} = (1.03 \pm 0.01) \cdot 10^{-9}$ ohm. The results show that the small slope of the characteristics for small valve currents is caused by the particular method of measurement only. The second method for the determination of characteristics is the more accurate one. (ATD)

8028 ON THE RESISTANCE BEHAVIOR OF SOME SUPERCONDUCTORS OF THE β-W TYPE ABOVE THE TRANSITION TEMPERATURE. Otto, G.; Saur, E. (Univ., Giessen, Ger.). Z. Naturforsch., 20a: 975(July 1965). (In German).

Measurements of the resistance behavior on a series of fused samples with β-W structure (V_3Si, V_3Ga, Nb_3Sn, Nb_3Al, and Nb_3Ga) were carried out, and the results are reported. As an example of the results obtained, measurements of the resistance pattern of a V_3Si melt in the untempered and tempered state from the transition temperature to over 40°K are graphed. The resistance increases with the temperature. With none of the samples was the irregular resistance change reported previously observed. (J.S.R.)

8029 THE TRANSITION OF SUPERCONDUCTIVITY IN SINTERED SAMPLES OF THE Nb–Sn SYSTEM. Meyer, G. (Univ. Giessen, Ger.). Z. Phys., 189: 191-8(1966). (In German).

For samples of the system Nb–Sn sintered between 700 and 1500°C with 20 and 25 percent Sn the inductive and resistive transition to superconductivity was measured. Especially the influence of magnetic fields on the transition was examined. The inductive transition is deduced from shielding currents, the anomalous rise of the transition temperature for the 4Nb: 1Sn-samples turns out to be a consequence of higher critical currents of these samples. At low sintering temperatures a rise of the critical fields was observed. (auth)

8030 THE PENETRATION OF A WEAK MAGNETIC FIELD IN SUPERCONDUCTORS OF Nb_3Sn, Nb_3Al, AND V_3Si. Meyer, G. (Univ. Giessen, Ger.). Z. Phys., 189: 199-206(1966). (In German).

The temperature variation of the initial susceptibility was measured for bulk sintered and diffusion samples as well as for finely ground sintered and melted samples of superconducting Nb_3Sn, Nb_3Al, and V_3Si. Penetration effects must be accounted for the width of the inductive transition curve if the interior of the sample is not completely shielded by current loops. Absolute values of the penetration depths after extrapolating to zero temperature were estimated to $(0.18 \pm 0.04)\mu$ for Nb_3Sn, $(0.19 \pm 0.04)\mu$ for Nb_3Al, and $(0.27 \pm 0.05)\mu$ for V_3Si. The transition temperature obtained by susceptibility measurements is lowered with decreasing grain size. (auth)

8031 AN INVESTIGATION OF THE SUPERCONDUCTING PROPERTIES OF MOLYBDENUM. Dyakov, I. G.; Shvets, A. D. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksp. Teor. Fiz., 49: 1091-3(Oct. 1965). (In Russian).

The superconducting properties of very pure molybdenum $R(4.2°K)/R(293°K) = 6 \times 10^{-5} > 99.9999\%$ are investigated. The superconducting transition temperature is found to be 0.916°K and the width of the transition range is 0.002°. The temperature dependence of the critical magnetic field was measured in a longitudinal magnetic field. In $H(T^2)$ coordinates it is found to be linear. The value $H_0 = 86$ Oe was obtained by extrapolating to zero temperature. It is shown that the value of T_c may increase with increase of impurity of the molybdenum. (auth)

8032 MAGNITUDE OF THE CRITICAL JOSEPHSON TUNNEL CURRENT. Kulik, I. O. (Physico-Technical Inst. of Low Temperatures, Academy of Sciences, Ukrainian SSR). Zh. Eksp. Teor. Fiz., 49: 1211-14(Oct. 1965). (In Russian).

It is shown that the maximal magnitude of the superconducting tunnel current at a zero potential difference is always smaller than the current in the normal state for a shift of $\pi\Delta/2$ (providing effects due to restriction of the Josephson current by its own magnetic field are not taken into account). (auth)

8033 NUCLEAR MAGNETIC SUSCEPTIBILITY OF LIQUID AND SOLID ^{3}He [Thesis]. Thomson, Alexander Low. Durham, N. C., Duke Univ., 1963. 181p.

The nuclear magnetic susceptibility of liquid and solid ^{3}He was measured at various pressures down to temperatures as low as 0.05°K. Relative values of the susceptibility were obtained from the heights and areas of the nuclear magnetic resonance line, which was found by a steady state method. In experiments on the liquid, the sample had a purity of 99.1%. The results show behavior expected of a Fermi liquid with effective Fermi temperatures extending from 0.430°K at 0.5 atm to 0.258°K at 30.7 atm. From the values of the effective Fermi temperatures found at several pressures, an estimate was made of the variation with pressure of the exchange energy between the quasi-particles of Landau's theory. A check was also made of the validity of Goldstein's theory by comparing the calculated specific heat, deduction from the susceptibility measurements presented here, to the experimental results on the specific heat. In experiments on the solid the purity of the sample was better than 99.95%. Experiments were performed in both the alpha and beta phases with molar volumes extending from 24.32 to 19.70 cm^3/mole. The magnetic susceptibility appeared to obey a Curie-Weiss law expected of a compound with antiferromagnetic coupling. The results show that, for molar volumes above about 22 cm^3/mole, the Curie temperature is of the order of 0.01°K. At smaller molar volumes the apparent Curie temperature increased as the molar volume was reduced reaching a value of 0.14 ± 0.03°K for a molar volume of 19.70 cm^3/mole. The results are compared to those expected from specific heat and relaxation time measurements and from theoretical predictions. (Dissertation Abstr.)

8034 HEAT TRANSFER TO A SATURATED BATH OF LIQUID HELIUM(II) [Thesis]. Irey, Richard K. Lafayette, Ind., Purdue Univ., 1964. 166p.

Heat transfer from a horizontal cylinder of 1.88-mm diameter to a saturated bath of liquid helium(II) was experimentally investigated in an apparatus built for this purpose. The range of cylinder-to-bath temperature differences from 10^{-2} to 10^{2}°K, where no data had previously existed, was investigated at bath temperatures of 1.61, 1.75, 1.96, and 2.10°K. The standing head of liquid helium above the test section was investigated as a parameter by keeping the immersion depth constant at 3.8 and 15.3 cm during the measurements. The results show that at temperature differences below 2×10^{-2}°K the heat transfer coefficient was independent of temperature difference and level but varied as the cube of the bath temperature. Above 2×10^{-2}°K the heat transfer coefficient was dependent upon the temperature difference, but not on immersion depth up to temperature differences of about 10^{-1}°K where transition to film boiling took place. Above transition the heat transfer coefficient decreased monotonically with increasing temperature difference. The larger depth caused a fifty to one hundred percent increase in the heat transfer coefficient, depending upon the bath temperature and temperature difference. These results are totally different both in magnitude and functional dependence from comparable measurements made in liquid helium(I). The large depth dependence in film boiling in helium(II) shows that liquid helium(II)'s "superfluidity" has had a significant influence on the results. (Dissertation Abstr.)

Neutron Physics

See also REACTOR TECHNOLOGY — Criticality Studies

Refer also to abstracts 7673, 8074, and 8386.

8035 (GA–5798) INTEGRAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1963–September 30, 1964. Beyster, J. R.; Brown, J. R.; Corngold, N. (and others) (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Oct. 15, 1964. Contract AT(04-3)-167. 227p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Measurements of neutron spectra were performed in H_2O, D_2O and BeO in various geometries with various poisons. The agreement between the measured and theoretical spectra was improved considerably since last year. These improvements were predominantly experimental in nature. Single differential scattering measurements were performed on H_2O with improved geometries and samples utilizing better multiple scattering correction procedures. Studies of multiplying assemblies were made which produced conclusions on the feasibility of reactivity measurements by pulsed neutron methods. In addition, improved background correction procedures were discovered in spectral measurements in multiplying assem-

blies. The analysis of preliminary fast neutron penetration measurements in graphite and water showed particular difficulties, indicating a need for improved neutron shielding computer codes. Experimental problems still remain in the fast neutron time of flight spectral measurements. The solution of these problems was started and, in addition, studies of the experimental problems in intermediate energy neutron spectra measurements were initiated. The major effort of the theoretical group has been directed to the development of a general computer code capable of calculating the scattering kernel for most moderators. This code is becoming operational and should soon provide useful results. It is anticipated that this code will be of great help in reactor design and will aid research into each moderator. Other phenomena which were investigated are the intermolecular scattering in D_2O, coherent elastic scattering in BeO, the scattering kernel for polyethylene and the lattice vibrational spectra of magnesium and zinc. (M.O.W.)

8036 (INR-637/IX-A/R) SOLUTION OF THE TIME DEPENDENT TRANSPORT EQUATION FOR A NON-UNIFORM SLAB. Mika, Janusz (Institute of Nuclear Research, Warsaw (Poland)). June 1965. 25p. Dep.

Time dependent neutron transport in a plane slab of material with variable nuclear properties is discussed. The one-velocity theory and isotropic scattering are assumed. The spectral properties of the corresponding Boltzmann operator are found and the initial value problem is solved. (auth)

8037 (JINR-P-2415) TSEPNAYA REAKTSIYA NA BYSTRYKH NEITRONAKH V PLOSKOI RESHETKE. (Chain Reaction with Fast Neutrons in a Plane Lattice). Chermak, I.; Marek, I.; Grmela, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 10p. Dep. mn.

Using the solution of the kinetic equation the chain reaction with fast neutrons in an infinite heterogeneous medium consisting of ^{235}U and ^{238}U plates placed in turn is investigated. The material parameter B was calculated for a 10, 20, and 30% enrichment with ^{235}U for different dimensions of the lattice. (auth)

8038 (KAPL-3095) VARIATIONAL MULTICHANNEL SYNTHESIS WITH DISCONTINUOUS TRIAL FUNCTIONS. Wachspress, E. L.; Becker, M. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 1965. Contract W-31-109-eng-52. 55p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

A variational formulation of multichannel synthesis is developed for neutron diffusion computations through use of a functional which admits discontinuous trial functions. Detailed equations are given for a particular choice of trial functions. A variational depletion formalism is described for conducting reactor life studies with a multichannel synthesis calculation model. (auth)

8039 (LA-3373) DTF-IV—A FORTRAN-IV PROGRAM FOR SOLVING THE MULTIGROUP TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING. Lathrop, K. D. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). July 15, 1965. Contract W-7405-eng-36. 141p. Dep. mn; CFSTI $4.00 cy, $1.00 mn.

The theory and the use are described of a code designed to solve, by the methods of discrete ordinates, the multigroup, one-dimensional (plane, cylinder, sphere) Boltzmann transport equation, including anisotropic scattering. Anisotropic scattering is represented by Legendre-polynomial expansion of the differential scattering cross section, which is truncated. Complete (in energy) scattering transfer matrices are allowed for as many scattering expansion coefficients as are permitted by machine storage limitations. Included are flow diagrams of the code, a code listing, and results of a test problem. (auth)

8040 (NAA-SR-Memo-11239) THE AGE OF FISSION NEUTRONS TO INDIUM RESONANCE ENERGY IN ALUMINUM-WATER MIXTURES. PART II. THEORETICAL ANALYSIS. Alter, Harry (Atomics International, Canoga Park, Calif.). Nov. 1965. Contract AT(11-1)-Gen-8. 144p. Dep. mn; CFSTI $4.00 cy, $1.00 mn.

The Monte Carlo code TYCHE-III is used to calculate with a high degree of convergence the second, fourth, and sixth spatial moments of the slowing-down density distribution at the indium resonance energy, for neutrons originating from a fission source at a point in infinitely extended aluminum-water moderator. The effects of both inelastic scattering and anisotropy of elastic scattering in oxygen and aluminum are included. The calculations are performed using several available sets of evaluated aluminum cross section data. These calculations are compared with the moments of experimentally measured distributions of neutron flux at the indium resonance energy, after applying a suitable correction to the computed slowing down moments. The agreement between the measured and calculated values for the neutron age and higher moments is found to be reasonably satisfactory for the low aluminum-water volume ratios and somewhat less satisfactory for the high metal-water volume ratio. (auth)

8041 (ORNL-TM-1241) LEGENDRE—A PROGRAM TO CALCULATE LEGENDRE COEFFICIENTS FROM ANGULAR DISTRIBUTIONS. Irving, D. C.; Kinney, W. E.; Rea, Pat (Oak Ridge National Lab., Tenn.). Nov. 1965. Contract W-7405-eng-26. 40p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

LEGENDRE is a FORTRAN program, written for either the CDC 1604 or IBM 7090, to calculate the coefficients of the Legendre expansion of an angular distribution. The angular distribution, represented by either the differential cross section or a probability distribution, may be specified at arbitrary values of the cosine with linear interpolation between given values. The Legendre coefficients are punched on cards in the format used by the 05R cross-section-handling package. Comparisons are made between the initial distribution and the calculated Legendre expansion. (auth)

8042 (TID-22446) THE $^{9}Be(n, 2n)$ REACTION AND ITS INFLUENCE ON THE AGE AND FAST EFFECT IN BERYLLIUM AND BERYLLIUM OXIDE [Thesis]. Perkins, Sterrett Theodore (Aerojet-General Nucleonics, San Ramon, Calif.). Oct. 1965. Contract AT(04-3)-368. 263p. (AN-1443). Dep. mn; CFSTI $6.00 cy, $1.50 mn.

The age and fast effect in beryllium and beryllium oxide are calculated from a solution of the moments equations in the multigroup approximation. The group structure involves 66 groups from 14.9 Mev down to 1.12 ev. The analysis includes a complete evaluation of the cross sections, angular distributions, and decay modes for all neutron-induced reactions in beryllium and oxygen. The principal decay mode of the ^{9}Be (n,2n) reaction appears to be through inelastic excitation of the 2.43-Mev level in ^{9}Be. This level decays by neutron emission mainly to the 2.90-Mev level in ^{8}Be, and also, to a much lesser extent, to the ground state of ^{8}Be. The next largest contribution to this reaction is through a multibody breakup to the ground state of ^{8}Be. Analytical expressions for the Legendre components of the multigroup transfer matrices are specified for neutron degradation by (n,2n) reactions and elastic and inelastic scattering (both by level excitation and the evaporation model). The specification of the transfer matrices for the $A(n,n_1)A^*(n_2)(A-1)^*$ reaction and the $^{9}Be(n,n_1)^{9}Be^*(\alpha_1)^{5}He^*(n_2)\alpha_2$ reaction are simplified by theorems describing time-successive nuclear reactions. These theorems give the Legendre components of the collision integral in the transport equation in terms of those of the individual processes in the chain. Other forms of the (n,2n) reaction for which transfer matrices are developed are the cluster model, the n-body phase space model, and the evaporation model. The transfer matrices and a group cross section generator are programmed for the IBM-7079/94 computer (the AGN-SIGMA code). Both the P_0 and P_1 transfer matrices are calculated for all reactions and the (n,2n) reaction is found to be highly anisotropic, particularly for the second neutron. However, neither the age nor the fast effect is strongly dependent upon this anisotropy nor the spectra of this reac-

tion. The fast effect and age are calculated by the INFIRM (IBM-7090/94) computer code, and compared with experimental results. (auth)

8043 (TID–22447) USERS MANUAL FOR AGN-SIGMA: A CODE TO CALCULATE THE LEGENDRE COMPONENTS OF THE MULTIGROUP TRANSFER MATRICES AND THE GROUP CROSS SECTIONS. Perkins, S. T.; Thompson, D. W.; DuBois, P. J. (Aerojet-General Nucleonics, San Ramon, Calif.). Oct. 1965. Contract AT(04-3)-368. 35p. (AN–1447). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The AGN-SIGMA code is used to calculate the Legendre components of the multigroup transfer matrices through the fifth degree, for fast neutrons. Reactions considered are elastic scattering, inelastic scattering (level excitation and the evaporation model), and the (n,2n) reaction (five decay modes). The code is also used to calculate group-averaged cross sections, as well as to manipulate, e.g., add, multiply, etc., the output matrices. The neutron spectrum may be a combination of fission and 1/E or arbitrary input data. The calculation is limited to 100 groups and 50 groups downscatter. The program is written in FORTRAN II language for the IBM 7090/94 computer. Computer time for complex problems may vary from several minutes (scattering reactions) up to an hour (the n,2n) reaction). (auth)

8044 (UCRL–7630(Suppl.1)) YOGI-N NEUTRON MONTE CARLO PROGRAM (CDC 3600 VERSION). Doyas, Richard J. (Lawrence Radiation Lab., Univ. of California, Livermore). July 29, 1965. Contract W-7405-eng-48. 15p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The YOGI-N program, an LRL neutron Monte Carlo code originally written in FORTRAN II language for the IBM 7090/7094 computer, is modified to a form appropriate for compilation on the CDC 3600/6600 system. The modifications incorporated, and the new input format, are described. The associated code TAPEMAKER, which prepares a cross-section tape for the YOGI-N program, is also translated. (auth)

8045 (AI-Trans–203) CALCULATION OF THE STREAMING EFFECT IN A CENTER VOID CHANNEL OF A REACTOR BY MEANS OF A FICTITIOUS MEDIUM REPRESENTATION. Maerkl, Hans. Translated by Eric H. Ottewitte and S. Thomas (Atomics International, Canoga Park, Calif.), from Nukleonik, 6: 288-99(1964). 7p. Dep. mn; JCL $1.10 fs, $0.80 mf.

Neutrons entering a void channel at the appropriate angle escape from the reactor causing a reactivity loss. Pershagen and Laletin have obtained from transport theory effective diffusion theory boundary conditions for use at the boundary of the void channel. They are of the form $\phi + \lambda (d\phi/dr) = 0$ where Pershagen and Laletin each give their approximation for λ. Based on the conclusions of Pershagen and Laletin, it is shown that the introduction of an appropriately defined fictitious medium into the channel is equivalent to the above effective boundary conditions. The medium is fictitious as it exhibits neither absorption nor moderation; the only parameter is the diffusion coefficient which depends on λ. This method will serve equally as well as the boundary condition methods in calculating the streaming effect in void channels. (auth)

8046 THE STUDY OF SOLIDS AND LIQUIDS USING THERMAL NEUTRONS. Marshall, W. (Atomic Energy Research Establishment, Harwell, Eng.). Advance. Sci., 22: 189-94(July 1965).

The principles involved in the use of thermal-neutron beams to study solids and liquids are outlined. A study is made of how the solid or liquid sample scatters the neutrons into various directions and various velocities. The neutrons produced in a reactor typically have wavelengths which also are of the order of 10^{-8} cm, and therefore they display the same kind of diffraction effects as x rays. Because neutrons interact with nuclei the neutron diffraction pattern leads eventually to a map of nuclear density. The second important point which makes neutrons useful is that the neutron has a magnetic moment which interacts with any magnetic moments in the scattering material. Therefore, if the scattering material has any magnetic properties, the neutron diffraction pattern can be used to produce a map of the magnetic moment density. A major use of neutron diffraction is to detect magnetic moment arrangements. A map of the magnetic moment density in NiO is used to illustrate another use of neutron diffraction, namely, how the magnetic moment is distributed, to gain information about the nature of the chemical bond between nickel ions and oxygen ions. The process by which a neutron scatters inelastically off a solid is described. Liquids provide the most straightforward example of a complex situation which can be studied by neutron scattering, but other complex situations also occur. For example, a magnetic solid at high temperatures has extremely complicated movements of the magnetic moments, too complicated for a simple analysis but amenable to investigation through defining probability functions and using neutron scattering. Furthermore any material close to a second order phase transition (no latent heat) is extremely complex because at such a point the thermodynamic fluctuations become large. Neutron scattering experiments have contributed profoundly to an understanding of such phase transitions. (BBB)

8047 SOLUTIONS OF THE MONOENERGETIC BOLTZMANN EQUATION BY USING JACOBI POLYNOMIALS. Nonnenmacher, Theo (Technische Hochschule, Karlsruhe, Ger.). Atomkernenergie, 10: 408-11(Nov.-Dec. 1965). (In German).

The Boltzmann equation for monoenergetic neutrons in a plane geometry with isotropic scattering is expanded by using Jacobi polynomials. The characteristic equation is given in a closed form valid for any approximation of order N. In the limit $N \to \infty$ this characteristic equation yields the exact characteristic equation for the discrete spectrum of the Boltzmann operator for all Jacobi polynomial systems. In a N = 3 approximation the lowest eigenvalues and the extrapolated endpoint are given for some Gegenbauer polynomial systems. A comparison with the exact values shows that all Gegenbauer polynomial systems with $-1 \leqq \delta < 0$ will give a better approximation for absorbing media then Legendre polynomials do. (auth)

8048 BOUNDARY VALUE PROBLEMS IN TRANSPORT THEORY. Hejtmanek, H. (Atominstitut, Vienna). Atomkernenergie, 10: 411(Nov.-Dec. 1965). (In German).

A method is presented for solving the Boltzmann equation under specific boundary conditions, and is applied to the problem of neutron transport in plane geometry and with isotropic scattering. (L.B.S.)

8049 ON THE NUMERICAL SOLUTION OF CHANDRASEKHAR-SYSTEM. Patry, J. (Eidg. Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Atomkernenergie, 10: 412-13(Nov.-Dec. 1965). (In German).

The system of Chandrasekhar with the two coupled integral equations was examined numerically and analytically. The solution is by no means unique; an unlimited number of solutions exists. The work of Mullikin was extended and the system separated in two linear integral equations, which both show a quasisingular character. (auth)

8050 ON THE TIME-BEHAVIOUR OF A PULSE GENERATED NEUTRON CLOUD. Mueller, K.-H.; Kschwendt, H. (Univ., Graz, Ger.). Atomkernenergie, 10: 424-8(Nov.-Dec. 1965). (In German).

Three characteristic phases can be distinguished in the time behavior of neutron bursts in finite systems: (a) the expansion phase, i.e., the neutron cloud generated by a point burst spreads as if in an infinite medium; (b) the perturbation phase, i.e., the neutron cloud becomes distorted by inhomogeneities of the material; (c) the relaxation phase, i.e., the normal asymptotic behavior. The first two phases have a wave-like behavior while in the third phase the neutron population approaches an exponential time decay. When the time behavior can be separated from the other variables, a fundamental mode is established. Normally pulsed experiments are studied only at the end of the relaxation phase. On the other hand, in many

pulsed neutron experiments, the fundamental mode is observed very late, when the neutron density has become inconveniently small. In such a case, most of the neutrons are wasted. However, if the expansion and perturbation phases are examined very carefully, a great deal of information about reactor and material parameters can be derived. By using the Monte Carlo Method, calculations can be performed which give an accurate description of the expansion and perturbation phases and are a good test for analytical investigations. Therefore the expansion and perturbation phases were considered in several nonmultiplying assemblies due to a local neutron pulse. The results verify the wave-like character of these phases. (auth)

8051 NEUTRON SPECTRA IN HOMOGENEOUS INFINITE MEDIA. Rietschel, H. (Technische Hochschule, Karlsruhe, Ger.). Atomkernenergie, 10: 447-8(Nov.-Dec. 1965). (In German).

A method is presented for calculating neutron spectra in homogeneous infinite media for an absorption proportional to $E^{-\frac{1}{2}}$. It is shown that the properties of the moderator concerning thermalization can be characterized by 5 parameters with excellent accuracy. This procedure represents an enlargement of a method given by Kunze, where the heavy gas operator is replaced by a Horowitz-operator. (auth)

8052 NEUTRON TRANSPORT IN DIFFERENTIALLY HEATED MEDIA. Williams, M. M. R. (Univ. of Birmingham, Eng.). Brit. J. Appl. Phys., 16: 1727-32 (Nov. 1965).

Calculations were made of the average energy of neutrons diffusing in an infinite, non-absorbing moderator possessing an arbitrary temperature gradient. The results are based upon the heavy gas model of neutron scattering, but the exact neutron transport equation is employed; thus it was possible to assess the accuracy of diffusion theory for this type of problem. By specializing to the well-known "Kottwitz problem" it is concluded that diffusion theory may only be used if the cross sections are fairly constant and the rate of energy exchange between neutrons and moderator nuclei is small. (auth)

8053 SELF-SHIELDING FACTORS FOR RESONANCE FOILS. Yamamoto, Hisashi; Yamamoto, Kazuko (Central Research Lab., Hitachi Ltd., Japan). J. Nucl. Sci. Technol. (Tokyo), 2: 421-4(Oct. 1965).

Self-shielding factors are obtained for indium, gold, tungsten, cobalt and manganese resonance foils using the ZUT code, and taking into account the effects of Doppler broadening and of potential and resonance scatterings. (L.B.S.)

8054 THE CORRECTION FACTOR FOR FAST NEUTRON REACTIONS ON SULFUR AND OXYGEN IN THE MANGANOUS-SULFATE-BATH CALIBRATION OF NEUTRON SOURCES. Murphey, W. M. (National Bureau of Standards, Washington, D. C.). Nucl. Instrum. Methods, 37: 13-21(Nov. 1965).

A Monte Carlo calculation is made of the correction for neutrons lost to (n,α) and (n,p) reactions with sulfur and oxygen in the manganous sulfate bath calibration of neutron sources. The correction factor is given as a function of initial neutron energy for monoenergetic neutrons in an infinite bath and as a function of manganous sulfate concentration. The correction factors for various source spectra are also given. The uncertainty in the correction for a given source spectrum owing to uncertainties in the source spectrum is much larger than those owing to the Monte Carlo calculation or the cross sections. (auth)

8055 REMOVAL OF SECOND ORDER NEUTRONS BY ORIENTED SINGLE CRYSTAL FILTERS. Iyengar, P. K.; Soni, J. N.; Navarro, Q. O.; Pineda, V. M.; Natera, M. G.; Lee, T. C.; Marsongkohadi; Song, J.; Nimwanadon, T. (Philippine Atomic Research Center, Quezon City). Nucl. Instrum. Methods, 37: 121-4(Nov. 1965).

Single crystals with large mosaic spreads have large values for total cross section, for neutrons corresponding to energies at which Bragg reflections occur. It is suggested that such crystals can be oriented to reflect away second-order neutrons from a crystal monochromator in the wavelength range 1 to 2 Å, without affecting the first-order neutrons in the wavelength range 2 to 4 A. The experiments verify this possibility. The accidental occurrence of "d" spacings of Pb (111) and Al (220), 2.853 Å and 1.429 Å respectively, in the ratio 2:1, makes it possible to couple them such that while Pb (111) is used for the monochromator, the aluminum crystal can reflect away the second-order component, and by coupling them to have the same angular rotations, monochromatic neutrons of continuously variable energy in the wavelength range 2 to 4 Å can be selected for experiments in neutron spectrometry. (auth)

8056 FUNDAMENTALS OF NEUTRON TRANSPORT THEORY [Thesis]. Roy, Donald Henry. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1964. 174p.

A consistent and detailed development and analysis of the important features of the spherical harmonics method in neutron transport theory is presented. The classical P_L and B_L approaches are derived, and the relationships between them are examined thoroughly. An interpretation of the B_L approximation is presented, which leads to a new spherical harmonics method incorporating both the P_L and B_L approximations as options. Important conclusions regarding the identification of the B_L approximation with asymptotic reactor theory are noted for both the energy-dependent and monoenergetic transport equations. An interpretation and extension of the classical slowing-down approximations in reactor physics is given for both isotropic and anisotropic elastic scattering in the center-of-mass coordinate system. A description and typical results of an extensive program for evaluating the anisotropic elastic scattering parameters are presented. The program is designed to be of general utility in formulating useful multigroup calculational models. (Dissertation Abstr.)

8057 CRYOGENIC NEUTRON SPECTRA MEASUREMENTS ACROSS A DISCONTINUITY IN TEMPERATURE AND PROPERTIES [Thesis]. Thompson, Byron Edwin. Austin, Tex., Univ. of Texas. 157p.

Thermal neutron spectra were measured across a discontinuity in temperature and properties. The discontinuity was between a graphite region at room temperature (the reflector of The University of Texas TRIGA reactor) and a slab of paraffin at liquid nitrogen temperature. Spatial variations of the spectra were measured at two angular positions, zero and forty degrees to the direction of the flux gradient. Spectra measurements were made at the discontinuity and in the paraffin. Energy distributions were measured by using a conventional chopper time-of-flight analyzer. The data were reduced by the usual corrections applied to time-of-flight data. A new correction is presented that accounts for the time width of the neutron pulse leaving the chopper. (Dissertation Abstr.)

8058 THE ANGULAR THERMAL NEUTRON SPECTRUM IN THE VICINITY OF THE INTERFACE BETWEEN TWO MEDIA [Thesis]. O'Dell, Ralph Douglas. Austin, Tex., Univ. of Texas, 1965. 192p.

A technique was developed for representing the steady-state, angularly dependent, thermal neutron flux spectrum distribution in a one-dimensional, two-medium slab with a discontinuity in nuclear properties or temperature (or both) existing at the interface. All independent variables involved in the technique are real. Medium 1 occupies the nonpositive half-space $x \leq 0$; medium 2 fills the positive half-space $x > 0$. The technique involves no assumption as to the isotropy of the scattering. The technique is applied to a graphite-cold paraffin system to demonstrate the applicability of the method. (A.G.W.)

8059 COMPUTATION OF SCATTERING CROSS-SECTIONS FOR USE IN THERMAL NEUTRON TRANSPORT CALCULATIONS. Hutchinson, P.; Schofield, P. (Atomic Energy Research Establishment, Harwell, Eng.). 21p. (CONF-650501-18). ORINS. Gmelin, AED-CONF-65-115-12.

From the Application of Computing Methods to Reactor Problems, Argonne, Ill.

A FORTRAN code, SCAT, was written which uses a specially designed integration routine to evaluate the Legendre coefficients of the inelastic scattering cross sections directly from the data on the chemical binding of the moderator atoms, used in the calculation of the scattering law, without the intermediate evaluation of the scattering law itself. The method of computation for a complex distribution compares favorably in computer time with previous methods and is believed to have much greater numerical reliability. Details of calculations using SCAT are given, and numerical problems associated with evaluating thermal scattering cross sections are discussed. (M.J.T.)

Nuclear Properties and Reactions

Refer also to abstracts 6694, 7414, 7430, 7448, 7449, 7605, 7703, 7726, 7743, 7766, and 7872.

8060 (ANL–7095) DIFFERENTIAL CROSS SECTIONS OF THE $^{9}Be(d,n)^{10}B$ REACTION. Buccino, S. G.; Smith, A. B. (Argonne National Lab., Ill.). Sept. 1965. Contract W-31-109-eng-38. 13p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Angular distributions of neutrons from the $^{9}Be(d,n)^{10}B$ reaction were obtained at deuteron energies of 2.6, 3.0, 3.1, 3.2, and 7.0 Mev by means of pulsed-beam time-of-flight techniques. Absolute measurements of the differential cross sections led to the following states in ^{10}B at a deuteron energy of 7.0 Mev: g.s., 0.72, 1.74, 2.15, 3.59, 4.77, 5.11 + 5.16, 5.90, 6.10, 6.35, 6.50, and 6.95 Mev. DWBA and Butler calculations were used to extract l_p values and spectroscopic factors for many of the levels observed. (auth)

8061 (CEA-R-2631) ETUDE ET REALISATION D'UN SPECTROMETRE β A CHAMP MAGNETIQUE AXIAL UNIFORME, MUNI D'UN SELECTEUR DE COINCIDENCE β-γ. ETUDE DES SPECTRES β DU ^{32}P, ^{203}Hg, ^{198}Au. MESURE DES COEFFICIENTS DE CONVERSION DU ^{203}Tl ET DU ^{198}Hg [Theses]. (Study and Construction of a β Spectrometer of Uniform Axial Magnetic Field Fitted with a β-γ Coincidence Selector. Study of the β Spectra of ^{32}P, ^{203}Hg, ^{198}Au. Measurement of the Conversion Coefficients of ^{203}Tl and of ^{198}Hg [Thesis]). Parsignault, Daniel (Institut National des Sciences et Techniques Nucleaires, Paris (France)). 1965. 70p. Dep. mn.

Submitted to Paris Univ. (France). Faculte des Sciences.

The principle of the beta spectrometer with uniform axial field using systematically the idea of caustics is discussed. The apparatus is described and its properties compared to those deduced from trajectory calculations. The β-ray and γ-ray detectors and the device for selecting coincidences with a 2 τ resolution of 5 nanoseconds are also presented. The spectrometer is used for studying reference elements and the most accurate results are confirmed. The β spectrum of ^{60}Co has a statistical form with an accuracy of 1 per cent; the maximum energy E_0 is 316.5 ± 1.5 kev. That of the $^{7}/_{2}+ \rightarrow {}^{11}/_{2}-$ transition for ^{137}Cs has a unique form, once forbidden. E_0 = 522 ± 3 kev. Conversion coefficients $\alpha_k = 96 \pm 1 \times 10^{-3}$ $\alpha L + M + N = 20.9 \pm 0.5 \times 10^{-3}$. The two β spectra of ^{59}Fe, separated by coincidence with the gamma, have the statistical form E_0 = 462 ± 2 kev (55.1 + 0.3 per cent) and E_1 = 275 ± 4 kev (44.9 ± 0.3 per cent). It is then verified whether the l selection rule is apparent in the shape of the phosphorus-32 beta spectrum. It is found in fact that it is not of statistical shape and its shape coefficient is determined. The study of the ^{203}Hg β spectrum followed by the 279 kev gamma spectrum is designed to determine the conversion coefficients. The interior spectrum of gold-198 is not of statistical shape either. The form coefficient is determined together with the conversion coefficients which are in slight disagreement with those calculated by Rose or Sliv. An interpretation of the spectrum is put forward which proposes an imperfect compensation for the various elements of the matrix. (auth)

8062 (COO–720–058) NUCLEAR PHYSICS LABORATORY PROGRESS REPORT, NOVEMBER 1, 1964–OCTOBER 31, 1965. (Case Inst. of Tech., Cleveland, Ohio. Dept. of Physics). Contract AT(11-1)-720. 61p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Brief summaries of 16 experimental and 34 theoretical research programs carried out at case during the period Nov. 1964 through Oct. 1965 are presented. The experimental research deals primarily with g-factor and half life measurements of rare earth isotopes. Some neutron scattering studies are also reported. References are given for most of the theoretical work and hence, few results are presented. (M.O.W.)

8063 (DESY–65/8) INTENSITY AND POLARISATION OF COHERENT BREMSSTRAHLUNG SPECTRA FROM A DIAMOND CRYSTAL IN UNIVERSAL REPRESENTATION. Timm, U. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sept. 1965. 22p. Dep. mn.

Plots of intensity and polarization functions are represented and their use is explained in obtaining the main features of coherent spectra produced from a diamond radiator for any desired electron energy and crystal orientation. The polarization to be expected may be obtained from the curves for the first peak of the spectrum, which gives the only significant contribution. In addition the contribution of a single lattice point is represented. (auth)

8064 (GEMP–388) NEUTRON CROSS SECTIONS FOR TANTALUM AND TUNGSTEN. Prince, A. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Nov. 12, 1965. Contract AT(40-1)-2847. 173p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

Neutron cross sections for ^{181}Ta, natural tungsten and its four main isotopes were calculated from 1 kev to 14 Mev. The total, elastic, inelastic, and differential scattering cross sections were computed using ABACUS II in which the equivalent local potential to the non-local potential of Perey and Buck were employed. The radiative capture cross sections were derived by the method due to Lane and Lynn where the low energy experimental data on resonance parameters were used in determining the average level spacings and strength functions. The results of the calculations are given in both graphical and tabular form and show very reasonable agreement with experimental data. (auth)

8065 (INP-426/PL) THE ELECTRIC DIPOLE SUM RULES AND THE INELASTIC ELECTRON SCATTERING FORM FACTORS OF THE 1^-, T = 1 STATES IN LIGHT NUCLEI. Czyz, Wieslaw (Institute of Nuclear Physics, Krakow (Poland)). Sept. 1965. 12p. Dep.

A simple analysis of the experimental data on the form factor of the 1^-, T = 1 states of light nuclei based on the electric dipole sum rules is proposed. (auth)

8066 (INR–618/XV/I) SUWAK DO OKRESLENIA CZESTOTLIWOSCI MAGNETYCZNEGO REZONANSU JADROWEGO. (Slide-Rule for Determination of the Frequency of Nuclear Magnetic Resonance). Chmielewski, J. (Institute of Nuclear Research, Warsaw (Poland)). Apr. 1965. 6p. Dep. mn.

A simple slide-rule is described which gives instant indication of nuclear magnetic resonance frequency for several isotopes placed in definite magnetic field. The slide-rule consists of two logarithmic scales which can be aligned depending on chosen isotope. (auth)

8067 (INSJ–88) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF SOME REACTIONS ON ^{12}C INDUCED BY 54.9 Mev PROTONS. Taketani, H.; Yamaguchi, H.; Muto, J.; Kokamo, J.; Itoh, H.; Baba, K.; Inoue, N.; Tomita, S.; Ueda, K.; Nakamura, H. (Institute for Nuclear Study, Tokyo Univ. (Japan)). Sept. 29, 1965. 23p. Dep. mn.

Numerical differential cross sections of (p,p), (p,p'), (p,d) and (p,t) reactions on ^{12}C are presented. The target used was ~100μ polyethylene (8.21 mg/cm^2). The energy of the incident protons accelerated with the INS synchro-

cyclotron was 54.9 ± 0.4 Mev. Momentum analysis of the reaction products was performed with a system of magnetic analyzer which was operated with momentum resolution of about 0.3%. Nuclear photographic plates of 100μ thickness were placed along the focal plane of the magnet and were used for the detection of the reaction products. In (p,p′) reactions, five prominent proton groups corresponding to the excitation energies of 4.43, 7.66, 9.64, 12.71, and 15.11 Mev in ^{12}C were observed. Angular distributions were obtained for these groups only. In (p,d) reactions, six prominent deuteron groups corresponding to the ground, first (1.99 Mev), second (4.38 Mev), third (4.82 Mev), fourth plus fifth (6.34 and 6.48 Mev), and sixth (6.90 Mev) excited states in ^{11}C were observed. Angular distributions were obtained for these groups only. In (p,t) reactions, only two prominent triton groups corresponding to the ground and first (3.34 Mev) excited states in ^{10}C were observed. Angular distributions were obtained for these groups only. Absolute cross sections were obtained in comparison with those of elastic scattering of protons by hydrogen nuclei contained in the polyethylene target. (M.O.W.)

8068 (JINR-D-2427) FISSION BY RADIATIONLESS TRANSITION IN THE MU MESONIC ATOM ^{239}Pu. Cojocaru, V.; Ignatenko, A.; Marinescu, L.; Omelianenko, M.; Petrascu, M.; Voiculescu, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 8p. Dep. mn.

The ratio of the radiationless probability and conventional fission of ^{239}Pu in mu-mesonic atoms were measured with a gas scintillation fission counter-chamber. The great contribution of the radiationless fission mechanism is observed. The increase of the probability of radiationless fission appears to be due to the change of the nuclear fission barrier under the effect of mu-mesons predicted by Zaretsky et al. (auth)

8069 (JINR-P-2383) IZYCHENIE REAKTSII RASSHCKEPLENIYA S POMOSHCHYU FOTOEMULSII. (Study of Spallation Reactions by Emulsions). Mekhedov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 24p. Dep. mn.

Experimental data are treated on star production by high energy particles at modern accelerators. Some features of star production on light and heavy emulsion components are pointed out. The resemblance and specific differences of stars produced by protons, neutrons, deuterons, and high-energy α-particles are discussed. (auth)

8070 (JINR-P-2423) IZMERENIE IONIZATSIONNYKH POTER PO POROGY IZLUCHENIYA VAVILOVA-CHERENKOVA. (Measurements of Ionization Losses by Vavilov-Cherenkov Radiation Threshold). Likhachev, M. F.; Stavinskii, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 8p. Dep. mn.

Mean losses of momentum for π^+ and μ^+ meson ionization at high energies were measured by Vavilov-Cherenkov radiation threshold. The measurements were carried out for liquid hydrogen and carbon. (auth)

8071 (JINR-P-2435) SPONTANNO DELYASHCHIICYA NEITRONODEFITSITNYI IZOTOP NEPTUNIYA S PERIODOM POLURASPADA 60 SEK. (Spontaneously Fissionable Neutron Deficient Isotope of Np with Half-life of 60 sec). Kuznetsov, V. I.; Skobelev, N. K.; Flerov, G. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1965. 8p. Dep. mn.

When bombarding ^{209}Bi with intensive fluxes of ^{22}Ne ions a new spontaneously fissionable product with half-life of $T_{½}$ (60 ± 5) sec was found in the internal beam of the multiply charged ion cyclotron. The excitation function of this product was investigated. It is shown that in the $^{209}Bi + ^{22}Ne$ reaction an anomalous spontaneous fission of one of the neptunium isotopes ^{227}Np or ^{228}Np is observed. (auth)

8072 (JINR-P-2441) VREMYA ZHISNI UROVNYA 226.9 kev V YADRE ^{155}Tb. (Lifetime of the 226.9 kev Level in the ^{155}Tb Nucleus). Bedrosyan, P.; Kuchma, A. S.; Morozov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 10p. Dep. mn.

The ^{155}Dy source was used for measurements. The coincidences of the 226.9 kev transition with hard γ rays were analyzed in the region of 660 kev. The experimental results yield the following values: the half life of 226.9 kev level is; $T_{½}\gamma = (3.4 \pm 0.5) \times 10^{-10}$ sec, the hindrance factors, according to Weisskopf and Nilsson, are equal to $F_W = 1.7 \times 10^4$ and $F_N = 0.4$, respectively. (auth)

8073 (KFK-321) ZUR BERECHNUNG DES BREMSSTRAHLUNTERGRUNDES IN γ-SPEKTREN. (On Calculation of Bremsstrahlung Background in γ-Spectra). Gantner, E.; Muenzel, H. (Kernforschungs-zentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). May 1965. 103p. Dep. mn.

The γ spectra of β emitters are always superposed on a continuum that can be traced back to internal and external bremsstrahlung. The evaluation of such spectra can lead to false results since in the analysis of bremsstrahlung continua by the subtraction method many γ energies appeared at random. The bremsstrahlung fraction, unknown for the most part in form and intensity, should be subtracted from each analysis of the total spectrum. This is especially necessary when radionuclides with high β maximum energy are investigated. From various authors, equations were derived by which the spectral pattern of the internal and external bremsstrahlung can be calculated. From such theoretical spectra, the bremsstrahlung distribution measured with a NaI scintillation spectrometer could be determined approximately with consideration of the response function of the detector. The accuracy with which experimental bremsstrahlung spectra could be calculated in this manner was investigated. The knowledge of the formation probabilities for the external and internal bremsstrahlung is necessary for the calculation of the theoretical spectra. These formation probabilities were determined as a function of the electron and photon energies and were tabulated. (tr-auth)

8074 (KFK-352) 26 GRUPPEN-WIRKUNGSQUERSCHNITTE FUER EUROPIUM, SAMARIUM, GADOLINIUM UND HAFNIUM. (26 Group Effective Cross Sections for Europium, Samarium, Gadolinium, and Hafnium). Schmidt, Josef Johannes; Siep, Irmgard (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Aug. 1965. 159p. Dep. mn.

Microscopic effective cross sections were compiled as a function of the neutron energy for Eu, Sm, Gd, and Hf, and were assigned to 26 group effective cross sections. For filling gaps in the data, statistical resonance theory, the optical model, and adjacent systematics were used. The results were compared with earlier compilations of microscopic effective cross sections and group constants. The accuracy of the cross sections obtained was discussed and the additional measurements needed on the four elements considered were compiled. (tr-auth)

8075 (NP-15648) METINGEN MET SCINTILLATIETELLERS AAN HET VERVAL VAN ^{115}Cd, $^{115}Cd^m$, ^{77}Ge EN $^{77}Ge^m$. (Measurements with Scintillation Counters on the Decay of ^{115}Cd, $^{115}Cd^m$, ^{77}Ge AND $^{77}Ge^m$ [Thesis]). Van Der Kooi, Johannes Bouke (Groningen Rijksuniversiteit (Netherlands)). [1964]. 94 p. Dep. mn.

The investigations of the γ-radiation observed in the β^- decay of four nuclei are described. Some properties of the NaI-scintillation spectrometers used are discussed. A non-linear relation between the γ-ray energy and the light output is demonstrated with a well-type crystal. This phenomenon explains the well-known non-linearity of the γ-ray energies observed in sum coincidence spectra. The resolving power of a number of scintillation spectrometers was measured for γ rays with energies between 31 and 1836 kev. The observed data support the theory of Iredale concerning the broadening of a γ photopeak. The equipment used and the methods of measurement and analysis are also discussed. The γ-γ angular correla-

tions of the 230 to 262 and 264 to 262 kev cascades in the ^{115}Cd decay ($\tau_{1/2}$ = 2.3 d) were measured. The measurements reduce the number of possible spin assignments to the low-lying ^{115}In levels. In the decay of ^{115m}Cd ($\tau_{1/2}$ = 43 d) several new, very weak, γ transitions were observed. The γ-γ angular correlation of the 485 to 935 kev cascade was measured. From this measurement and from considerations on γ-ray intensities and β-decay ft values, follow the spin and parity assignments $^7/_2^+$, $(^{13}/_2)^+$, $(^{11}/_2)^+$ and $^9/_2^+$ for the ^{115}In levels at 935, 1129, 1290, and 1420 kev, respectively. These levels can be regarded as generated by the removal of a $g_{9/2}$ proton from ^{116}Sn in its first excited state ($J^\pi = 2^+$). In the decay of ^{77}Ge($\tau_{1/2}$ = 11.3 h) and ^{77m}Ge ($\tau_{1/2}$ = 59 s) about 55 γ transitions are observed in single, coincidence and sumcoincidence spectra. Thirty of these transitions were not observed before. The γ-γ angular correlations of seven cascades are measured. The proposed decay schemes include the following ^{77}As levels: 215 ± 2($^3/_2^-$), 263 ± 2($^5/_2^-$), (325 ± 15), 473 ± 3($^9/_2^+$), 632 ± 2($^5/_2^+$), 755 ± 4, (925 ± 15), 1195 ± 3($^1/_2$,$^5/_2$), 1280 ± 8, 1457 ± 6, 1557 ± 4, 1700 ± 15, 2001 ± 6, 2109 ± 10, 2232 ± 9, 2347 ± 4, (2445 ± 15), and 2565 ± 25 kev. Six of these levels have not been reported before. (auth)

8076 (NP-15663) STANDARD REFERENCE MATERIALS: HALF LIVES OF MATERIALS USED IN THE PREPARATION OF STANDARD REFERENCE MATERIALS OF NINETEEN RADIOACTIVE NUCLIDES ISSUED BY THE NATIONAL BUREAU OF STANDARDS. Anspach, S. C.; Cavallo, L. M.; Garfinkel, S. B.; Hutchinson, J. M. R.; Smith, C. N. (National Bureau of Standards, Washington, D. C.). Nov. 15, 1965. 12p. (NBS-MISC.PUBL.-260-9). GPO $0.15.

Values are given for the half lives of materials used in the preparation of standard samples of ^{22}Na, ^{45}Ca, ^{46}Sc, ^{54}Mn, ^{57}Co, ^{60}Co, ^{65}Zn, ^{85}Kr, ^{85}Sr, ^{89}Sr, ^{90}Sr, ^{88}Y, ^{95}Nb, ^{125}I, ^{139}Ce, ^{141}Ce, ^{147}Pm, ^{203}Hg, and ^{204}Tl issued by the National Bureau of Standards. Instrumentation, source preparation, and the determination of impurities are also discussed. (auth)

8077 (NYO-72-52(Suppl.1)) CINDA—AN INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. (Columbia Univ., New York. ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France)). Oct. 15, 1965. Contract AT(30-1)-Gen-72. 207p. (EANDC-49(U) (Suppl.1); CCDN-CI/2(Suppl.1)). Dep. mn; CFSTI $6.00 cy, $1.25 mn.

This first supplement to CINDA '65 contains all the additions entered into the CINDA master library tape during the period May 1st to October 15, 1965. It contains in addition improvements to former entries including correction of errors and the introduction of uniformity wherever possible. (M.O.W.)

8078 (NYO-1082-2) REACTION STUDIES WITH FAST NEUTRONS. Report of Progress to October 31, 1965. Peck, R. A. Jr.; Maxson, D. R. (Brown Univ., Providence, R. I. Dept. of Physics). Nov. 1, 1965. Contract AT(30-1)-1082. 22p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Modifications to basic facilities include: completion of a new accelerator column; pressure stabilizing systems for accelerator and flow counters; elaboration of associated-particle neutron monitor and particle-discrimination system; and coding of angular distribution correction functions for computer. Definitive results were obtained in experiments on n-T scattering, ^{15}N(n,d)^{14}C, ^{14}N(n,t)^{12}C, and ^{14}N(n,α)^{11}B. These results include absolute cross sections and quantum number assignments, good fits to theoretical angular distributions, a discrimination among two-body interaction hypotheses and demonstration of strong competition with the direct (n,d) process through a new level of the compound nucleus ^{16}N. Preliminary results are reported for ^{107}Ag(n,α)^{104}Rh, neutron polarization from d + d at 160 kev, and counter studies of (n,d) reactions among the low cross sections of medium and heavy nuclei. Immediate plans, discussed in the accompanying Research Proposal, include studies of: (n,α) reactions of ^{16}O, ^{107}Ag (good geometry), ^{9}Be and ^{32}S; ^{34}S(n,d)^{33}P; and the reactions (n,p), (n,α) and (n,d) of ^{59}Co. Also under consideration are studies of n-^{3}He scattering, ^{6}Li(n,α), ^{7}Li(n,α), ^{34}S(n,α), ^{33}S(n,t) and ^{31}P(n,n'). Several of the projected studies are directed at a contested low state in ^{31}P. (auth)

8079 (ORNL-3855) NUCLEON-NUCLEUS AND PION-NUCLEUS COLLISIONS IN THE ENERGY RANGE 2 TO 10 Gev. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 135p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The energy distributions of high-energy (>500 Mev) nucleons and pions from nucleon-nucleus and pion-nucleus collisions in the energy range 2 to 10 Bev are calculated using a one-dimensional cascade model. Because of the one-dimensional approximation, no information concerning the angular distribution of the emitted particles is obtained. Also, only a two-component cascade, nucleons and pions, is considered, so the charge distribution of the emitted particles is not given. (auth)

8080 (ORNL-P-1700) α_K MEASUREMENTS FOR USE AS STANDARDS IN THE ENERGY RANGE 800 TO 1200 kev. Hamilton, J. H.; Amtey, S. R.; van Nooijen, V.; Ramayya, A. V. (Vanderbilt Univ., Nashville, Tenn.); Pinajian, J. J. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 5p. (CONF-651118-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Gatlinburg, Tenn.

A discussion is presented on conversion coefficient measurements and their role in the study of nuclear energy levels. Conversion coefficients which may be used as standards were measured for ^{54}Cr, ^{88}Sr, and ^{65}Cu. (M.O.W.)

8081 (ORNL-P-1786) BETA AND GAMMA TRANSITION PROBABILITIES. Gove, N. B. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 28p. (CONF-651118-3). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From American Physical Society, Gatlinburg, Tenn.

A survey is presented of systematics of log ft values, half lives for gamma transitions, and hindrance and enhancement factors for E1, E2, E3, M1, M2, M3, and M4 gamma transitions. 15 references. (T.F.H.)

8082 (ORNL-P-1793) COULOMB EXCITATION. Robinson, R. L. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 11p. (CONF-651118-4). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Gatlinburg, Tenn.

The contribution of Coulomb excitation studies for the determination of spins and parities for low-lying levels of stable nuclei is discussed. The value of Coulomb excitation for relating the spin and parity of the excited state to the spin and parity of the ground state and for providing information on the characteristics of the ensuing gamma radiation and internal conversion electrons is discussed. (M.O.W.)

8083 (PUC-937-171A) DIRECT (p,α) REACTIONS ON ISOTOPES OF COPPER AND ZINC [Thesis]. Nolen, Jerry A. Jr. (Princeton Univ., N. J. Palmer Physical Lab.). Aug. 1965. Contract AT(30-1)-937. 160p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

The (p,α) direct reaction was studied at a bombarding energy of 17.5 Mev. Isotopic targets of ^{63}Cu, ^{65}Cu, ^{64}Zn, ^{66}Zn, ^{68}Zn, and ^{70}Zn were used. Thin target data with 100 kev total energy resolution were obtained for four of these isotopes. The experiment was performed with an array of six solid state particle detectors. The Q values of the ground state transitions were found to agree within the experimental error of ±20 kev with those given in published mass tables. Three excited energy levels were populated in the previously unexplored ^{67}Cu nucleus. They are at excitation energies 1.12 ± 0.05, 1.67 ± 0.05, and 2.34 ± 0.05 Mev. Angular distributions of the alphas leading to the ground states and several excited states are presented for all six targets. These angular distributions were found to be characteristic of the angular momentum transfer. The corresponding curves from the different tar-

gets are very similar. There is very little Q value dependence in the shapes over a range of 3 Mev. A striking difference between the L = 1, J = $\frac{1}{2}$, and J = $\frac{3}{2}$ transitions was observed. The (p,α) spectra of a given residual nucleus was shown to be very similar to that of single proton pickup leading to the same nucleus. The resulting usefulness of the (p,α) reaction in locating proton hole states is pointed out. Levels which probably correspond to the four ($p_{\frac{3}{2}} f_{\frac{7}{2}}^{-1}$) proton hole states in ^{60}Ni were observed. The $f_{\frac{7}{2}}$ proton holes in the Cu isotopes were also located near 1.5 Mev excitation energy. There were two strong $\frac{1}{2}^-$ levels in each copper isotope. The implications of these low lying hole states for unified model calculations were discussed. The "collective" levels of ^{60}Ni and ^{62}Ni were excited appreciably by the (p,α) reaction. Relative yields to the 0^+, 2^+, and 4^+ members of the two phonon triplet were measured. The yield to the 0^+ state is only about 5 percent of that to the other two members. The low lying $\frac{1}{2}^-$ and $\frac{5}{2}^-$ levels of the Cu isotopes were very weakly excited. The distorted waves model of the (p,α) pickup mechanism is discussed in detail. Special cases are worked out and the method of calculation of (p,α) form factors is given. The distorted waves calculations reproduce the qualitative features of the data, but the shapes do not fit well. The choice of parameters is discussed. (auth)

8084 (UCRL-14007(Rev.1)) TABULATED NEUTRON-INDUCED GAMMA PRODUCTION CROSS SECTIONS FOR PRIMARY NEUTRON ENERGIES OF 0.1 TO 15 Mev. Chazan, Nanette J. (Lawrence Radiation Lab., Univ. of California, Livermore). Aug. 23, 1965. Contract W-7405-eng-48. 125p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Gamma-production cross sections, both integrated and differential, are tabulated. The data are categorized according to whether the gammas produced are continuum, discrete, or total over all gamma energies. (auth)

8085 (USNRDL-TR-916) GAMMA RAYS FROM (n,n'γ) INTERACTIONS OF 2.8 Mev NEUTRONS WITH MAGNESIUM, ALUMINUM, SILICON, TITANIUM AND IRON. Engesser, F. C.; Thompson, W. E. (Naval Radiological Defense Lab., San Francisco, Calif.) Oct. 4, 1965. 31p. CFSTI $2.00 cy, $0.50 mn.

The gamma rays from (n,n'γ) interactions of 2.8-Mev neutrons with magnesium, aluminum, silicon, titanium, and iron nuclides have been investigated. Cross sections for the production of many of these gamma rays are reported. It is shown that a correlation exists between the reduced quadrupole transition probability of a nuclear state and the excitation of that state by neutron inelastic scattering. (auth)

8086 (ZFK-TPH-15) SPEKTROSKOPISCHE INFORMATIONEN AUS DIREKTEN REAKTIONEN. (Spectroscopic Information from Direct Reactions). Riedel, Claus (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). Dec. 1964. 87p. Dep. mn.

A bibliographic study is made of the spectroscopic information available from direct reactions. Models for inelastic scattering are given. The spectroscopic information available from inelastic scattering processes includes information on the parity and structure of the excited levels. Single-particle reactions and the effective cross sections for such reactions are considered. The angular dependence and the reduced width are discussed. A theoretical description is given of two-particle stripping reactions. The spectroscopic information available is illustrated by the discussion of several reactions. (J.S.R.)

8087 (ZFK-TPH-16) UNTERSUCHUNG DER LADUNGSUNABHAENGIGEN PAIRING-KRAFT IM MODELL MIT EINER ENTARTETEN SCHALE. (Study of the Charge-Independent Pairing-Energy in a Model with a Degenerate Shell). Kissener, Hans-Rainer (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). Mar. 1965. 56p. Dep. mn.

Within the framework of a soluble model a study was made to determine whether the α structure can be explained with a charge-independent pairing energy generalized to the proton-neutron situation and the case of L-S coupling. A qualitative survey is obtained on the effect of the charge-independent pairing energy. (tr-auth)

8088 (ANL-Trans-242) ANGULAR DISTRIBUTIONS OF NEUTRON FISSION FRAGMENTS OF ^{230}Th, ^{238}Pu AND ^{241}Am. Vorotnikov, P. E.; Dubrovina, S. M.; Shigin, V. A.; Otroshchenko, G. A. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report IAE-817. 15p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf.

Assuming that the deformation of the nucleus prior to fission is axially symmetric, and that the divergence of the angular distribution of the fission fragments occurs essentially along the symmetry axis, it is shown that the angular distribution of the fission fragments depends on the angular momentum and on the projection of the angular momentum on the symmetry axis. An experimental study of the angular distribution of fission fragments from neutron fission of ^{230}Th, ^{238}Pu, and ^{241}Am at 50 to 1400 kev neutron energy is carried out in order to analyze the degree of deformation and the quantum characteristics of these nuclei in the vicinity of the saddle point. (T.F.H.)

8089 (BNL-tr-30) SOME PECULIARITIES OF THE EVAPORATION OF NEUTRONS FROM A SPINNING NUCLEUS. Strutinskii, V. M. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). Translated by Stephen Amoretty (Brookhaven National Lab., Upton, N. Y.). 6p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf.

An analysis of the neutron emission by nuclei following heavy-ion capture is presented, taking into account the high-angular-momentum states that can result from this type of reaction. The angular distributions of neutrons are derived, and it is found that maxima occur in the angular distribution at 0 and 180°. (T.F.H.)

8090 PHOTONUCLEAR REACTIONS. Danos, M. (National Bureau of Standards, Washington, D. C.); Fuller, E. G. Ann. Rev. Nucl. Sci., 15: 29-66(1965).

Recent developments in the field of photonuclear physics are reviewed. Computational methods and models that have contributed to the theoretical understanding of the photonuclear effect, and advances in experimental techniques that have allowed the measurement of parameters not previously amenable to experimental study are treated. Various discrepancies that need to be reconciled and the gaps that need to be filled are pointed out. (L.B.S.)

8091 NONSPHERICAL NUCLEI. Rogers, John D. (Niels Bohr Institutet, Copenhagen. Univ. do Rio Grande do Sul, Porto Alegre, Brazil). Ann. Rev. Nucl. Sci., 15: 241-90(1965).

A survey is made of some of the consequences observable in low-energy nuclear spectra resulting from the existence of nuclear states which can be described as having a nonspherical equilibrium shape. The special characteristics of the nuclear motion are discussed, which can be derived from considering only the symmetry properties of the potential together with the adiabatic premise that the rotation does not significantly perturb the potential. Following a survey of the collective model the particular characteristics of single-particle motion in the deformed potential is studied. Questions of predictions of the collective properties such as fundamental shape or the inertia parameter associated with the rotational motion are surveyed. (L.B.S.)

8092 REACTIONS BETWEEN COMPLEX NUCLEI. Greider, K. R. (Yale Univ., New Haven). Ann. Rev. Nucl. Sci., 15: 291-324(1965).

A general discussion is given of the mechanisms involved in heavy-ion elastic scattering and in direct-reaction transfer processes. Particular emphasis is given to semiclassical descriptions in order to clarify the roles of Coulomb scattering and diffraction scattering, both of which play important parts in heavy-ion reactions. A review of the theoretical treatments of the elastic scattering of complex nuclei is presented. It is shown that the specific models can be characterized by one or more of

three general categories, each of which represents a different technique for solving the scattering problem. The particle or cluster transfer model is treated. The applicability of the parameterized elastic scattering models is reviewed, as well as the various theoretical treatments of the reaction mechanism. Finally, a brief summary of some different aspects of heavy-ion reactions is given. (L.B.S.)

8093 STUDY OF THE CROSS SECTION OF THE REACTION $^{6}Li(d,\alpha)^{4}He$. Robaye, G.; Delbrouck, J. M.; Winand, L.; Quaglia, L. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 34: 324-9(1965) (In French).

The differential cross section at 90° of the reaction $^{6}Li(d,\alpha)^{4}He$ was measured for deuteron energies between 350 and 1500 kev. The knowledge of this differential cross section will serve to normalize the differential cross section of the concomitant reaction $^{7}Li(d,\alpha)^{5}He$; $^{5}He \rightarrow {}^{4}He + n$ for natural Li targets. (tr-auth)

8094 THE EXPERIMENTAL STUDY ON THE ENERGY SPECTRUM OF EMITTED PROTONS IN THE REACTION $^{27}Al(\gamma,p)^{26}Mg$ BY 22 Mev BREMSSTRAHLUNG. Kondoo, Motoo (Tokyo Inst. of Tech.). Bull. Tokyo Inst. Tech., No. 57: 57-60(Feb. 1964).

Information about the interaction between the nucleus and the photon was obtained by precise measurements of the energy spectrum of emitted protons from an aluminum foil irradiated by high energy (22 Mev) γ ray. (auth)

8095 EXCITATION FUNCTION OF THE NUCLEAR REACTION (d,2n) ON ^{232}Th BETWEEN 10 AND 22 Mev. Lagarde, Monique; Simonoff, Gabriel (Faculte des Sciences, Talence, Gironde, France). Compt. Rend., 261: 3364-5(Oct. 27, 1965). (In French).

The ^{232}Pa produced is identified using its daughter ^{232}U. This is extracted chemically in the presence of ^{233}U as a tracer. The measured cross sections are in good agreement with those of (d,2n) reactions studied on other heavy elements taking into consideration ratios of probabilities of evaporation and of fission (Γ_n/Γ_f). (tr-auth)

8096 STUDY OF THE EXCITED LEVELS OF ^{211}Bi. Briancon, Chantal; Foucher, Roger; Huc, Jean-Marie (Faculte des Sciences, Orsay, France). Compt. Rend., 261: 3366-9(Oct. 27, 1965). (In French).

The de-excitation of the levels of ^{211}Bi was studied using scintillation spectrometers and semicircular magnetic spectrometers. The results obtained are tabulated, and a level scheme is proposed. (J.S.R.)

8097 THE NEUTRONIZATION OF MATTER ON COLLAPSE AND THE NEUTRINO SPECTRUM. Zel'dovich, J. B.; Guseinov, O. Kh. Dokl. Akad. Nauk SSSR, 162: 791-3(June 1, 1965). (In Russian).

On compression to a density above 10^{6} to 10^{11} g/cm^3, stable nuclei are converted to neutrons. High-energy neutrinos are emitted during this process as contrasted to thermal neutrinos and antineutrinos emitted in the course of slow evolution of a star. It may be possible to detect these high-energy neutrinos experimentally. An analysis of the conversion of hydrogen to neutrons on compression by a free fall mechanism shows that the reaction time for 50% conversion is $\sim 10^{-2}$ sec at a threshold Fermi energy $E_F = 6.74$ Mev. Almost all the excess energy is imparted to the neutrino, whose average energy $E_\nu = 4.56$ Mev. The conversion of other nuclides to neutrons during collapse gives neutrinos having energies of 10 to 30 Mev. The flux of these high-energy neutrinos is estimated to be 3×10^{5} neutrinos/cm^2. sec. It may be possible to detect these neutrinos on earth because of their high energy. (TTT)

8098 HYPERNUCLEI. Setti, R. Levi (Univ. of Chicago). Endeavour, 24: 119-25(Sept. 1965).

The occurrence and properties of hypernuclei and the information about the forces acting between the Λ-hyperon and the nucleon that can be gained from studying them are discussed. Hypernuclear systematics, Λ-binding energies, and spins of hypernuclei are considered. Some properties of the light hypernuclei are tabulated, including all species that have been positively identified, and also those whose existence can be inferred with reasonable certainty. (L.B.S.)

8099 THE REACTIONS OF ^{12}C WITH 55 Mev PROTONS. Taketani, Hiroshi (Kyoto Univ.). Genshikaku Kenkyu, 8: 217-30(June 1963). (In Japanese).

Polyethylene was irradiated with 55 Mev protons, and the emitted particles were analyzed with magnetic spectrograph. The emitted particles (p, d, t, ^{3}He, ^{4}He) were focused on the nuclear emulsions plated on a focal plane. The cluster configuration of the target nucleus (^{12}C) was estimated from the yield ratio for each reaction such as (p,d), (p,t), (p,^{3}He), or (p,^{4}He). The momentum spectrum of reaction products show that the yields of these reactions are in comparable order. The nature of the state of each residual nucleus was studied from the angular distribution and the residual width corresponding to each residual state. (NSA of Japan)

8100 EFFECT OF RESONANCE ON NEUTRON SCATTERING BY CARBON. Biswas, Paresh Kumar (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 39: 297-9(June 1965).

Cross sections for elastic scattering of neutrons by ^{12}C at 4.1 and 2.7 Mev (lab. system) were calculated, taking into account the resonance level of the ^{13}C nucleus at 3.38 Mev (c.m.s.) which has the width $\Gamma = 1$ Mev. The results are compared with a previous calculation and experimental results. (L.B.S.)

8101 LIFETIME OF THE 114 Kev LEVEL OF ^{175}Lu. Ayyangar, K. M. M. S.; Lakshminarayana, V.; Jnanananda, Swami (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 3: 408-10(Oct. 1965).

The lifetime of the 114 kev level of ^{175}Lu was measured employing a time-to-amplitude converter and the half-life was found to be $10.6 \pm 1.1 \times 10^{-11}$ sec. An enhancement factor of 351 for the E2 and a retardation factor of 26 for the M1 multipoles were found for the 114 kev transition. The rotational parameters Q_0, B(M1), g_R and g_K were calculated and compared with values reported by earlier workers. (auth)

8102 TABLES OF REDUCED DIAGONAL MATRIX ELEMENTS FOR DIFFERENT TYPES OF NUCLEAR POTENTIAL. Kumar, Naresh; Kumar, Vijay; Bhanot, V. B. (Panjab Univ., Chandigarh, India). Indian J. Pure Appl. Phys., 3: 450-2(Nov. 1965).

Reduced diagonal matrix elements were calculated for four important types of nuclear potential: Gaussian potential, Coulomb potential in the limit $r_0 \rightarrow \infty$, a more singular potential at the origin, and Yukawa potential. These data should be useful for analysis of low-lying nuclear energy levels on the basis of the nuclear shell model. (auth)

8103 ON THE PHASE SHIFTS OF PROTON-^{4}He SCATTERING. Horikawa, Naoaki; Kanada, Hiroyuki (Nagoya Univ., Japan). J. Phys. Soc. Jap., 20: 1758-63 (Oct. 1965).

The phase shift analysis of the proton-^{4}He elastic scattering at 29, 40 and 55 Mev is performed. The opening of inelastic channels are taken into consideration by introducing inelastic parameters, that is, by using the complex phase shifts. The results are consistent with those derived from the meson theoretical nuclear forces (K. N. O. S. phase shifts). The phase shifts of proton-^{4}He scattering show strong energy and state dependences. D-wave phase shifts are negative in the low energy region and the l-s splitting in the D-state shows the inverted doublet splitting up to 55 Mev. (auth)

8104 ELASTIC NEUTRON SCATTERING ON THE ^{12}C NUCLEUS. Lovas, Istvan (Inst. of Theoretical Physics, Copenhagen. Central Research Inst. for Physics, Budapest). Magyar. Fiz. Foly., 13: 319-36(1965). (In Hungarian).

Use of the Feshbach theory for analysis of the fine structure of compound nuclear reactions is studied on the basis of neutron scattering on light nuclei. Data available on ^{12}C were examined using Lane's model, which describes the

low-excitation, even-parity state of ^{13}C. The partial and total scattering cross sections and the cms energy function were determined at 0.1 to 4.5 Mev. It was found that the states described by the energy functions are degenerate. It is concluded that the three-quasiparticle method based on Feshbach's theory may be used as an approximation method for analyzing the dynamic properties of light nuclei. (TCO)

8105 EXPERIMENTAL METHOD FOR MEASUREMENT OF CROSS SECTIONS OF NUCLEAR REACTIONS BY MASS SPECTROMETER. Bernas, R.; Gradsztajn, E.; Klapisch, R.; Yiou, F.; Den, Nguyen Long (Univ. de Paris, Orsay, France). Nucl. Instrum. Methods, 37: 141-51 (Nov. 1965). (In French).

A very sensitive technique, which applies to stable or radioactive isotopes produced in high energy nuclear reactions, is described. Its main feature consists in isolating the nuclear reaction products through their vapor pressure differences with that of the target material, thus reducing contamination to a minimum. The isotope dilution method is employed for absolute cross section determinations and, in this case, the spike is produced in situ by the nuclear reaction itself. A simple high-efficiency ion source with three accurately adjusted demountable filaments is especially designed for this work. Some results are given. (auth)

8106 SMALL-ANGLE SCATTERING AND ABSORPTION OF 3.0 Gev/c ANTIPROTONS IN NUCLEAR EMULSION. Faucher, G. (Laboratoire de Physique Theorique, Orsay, France. Laboratoire de Physique, Paris). Nuovo Cimento (10), 40A: 506-12(Nov. 21, 1965).

The eikonal approximation of the optical model is used to analyze the elastic and inelastic interactions of 3.0 Bev/c antiprotons in nuclear emulsion. The aim is to find the value of the real part of the nuclear scattering amplitude. The best fit with the experimental data is obtained with the parameters $R_0 = 1.57$ fermi, $W = 22.4$ Mev, $V_0 = 2$ Mev, yielding a ratio of the real to imaginary part of the scattering amplitude of 5%. (auth)

8107 A POSSIBLE DECAY OF ($^9Be_\Lambda$). Davis, D. Fournet (Seattle Pacific Coll., Washington); Gibbs, R. E.; Lord, J. J.; Piserchio, R. J. Nuovo Cimento (10), 40A: 662-7(Nov. 21, 1965).

A possible example of the decay of a $(^9Be_\Lambda)^*$ from an excited state was observed in interactions of 5-Bev/c K^- mesons in nuclear emulsions. The range, energy, and angle relations for the tracks associated with the decay are given and discussed in terms of identifying the particles involved. Three possible interpretations of the observed event are considered, and the postulated $(^9Be_\Lambda)^*$ decay is found to be consistent with the data and more probable than any other interpretation. (M.J.T.)

8108 DOUBLE-SCATTERING CORRECTIONS TO $\bar{K}$-MESON NUCLEAR ABSORPTION REACTION $\bar{K} + {}^4He \rightarrow \pi^- + \Lambda^0 + {}^3He$. Sawicki, J. (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Nuovo Cimento (10), 40A: 678-83(Nov. 21, 1965).

A virtual-target or Chew-Low-type approximation is used to calculate the double kaon scattering correction to the absorption reaction $\bar{K} + {}^4He \rightarrow \pi^- + \Lambda^0 + {}^3He$. The smallness of the correction effect is demonstrated semiquantitatively, for the case of the nS Bohr orbit quantum number. Numerical results of the ^3He momentum distribution are given for double scattering off a proton and off a neutron, for three sets of previous solutions. (M.J.T.)

8109 THE ANTIPROTON AS A NUCLEAR PROBE. Apostolakis, A. J.; Briggs, G. A.; Khan, N. A.; Major, J. V. (Univ. of Durham, Eng.). Nuovo Cimento (10), 40A: 268-72(Nov. 1, 1965).

The momentum distribution of recoiling nuclei in nucleon annihilation in the light elements of nuclear emulsions was investigated, using antiprotons as a nuclear probe. The experimental details of the exposure and scanning of the stack were previously described. It is considered that the momentum of the recoil is equal and opposite to that of the annihilated nucleon. It is concluded from the results that the momentum distribution of nucleons in light elements is of the form given by Gardon et al. for the protons of carbon; and that the annihilation appears to take place on p- and s-nucleons in the same proportions as they occur in light nuclei. (L.B.S.)

8110 STUDY OF π-He SCATTERING BETWEEN 500 AND 1200 Mev. Chavanon, Ph.; Crozon, M.; Leray, Th.; Narjoux, J. L.; Maric, Z. (College of France, Paris). Nuovo Cimento (10), 40A: 935-47(Dec. 1, 1965). (In French).

A counter experiment was performed to study the π-He interaction, in the 500 to 1200 Mev energy range. Measurements of the integral distribution of charged secondaries for forward angles between 4 and 30° in the laboratory system were carried out. The interpretation was made in the frame-work of the optical model, but the results led to a careful re-examination of the usual approximations of this model. While the validity of the impulse approximation is confirmed, it was found that both the nonlocality of nucleon forces and the Fermi motion of nucleons must be reconsidered. The nonlocality of nuclear forces leads to an apparent difference between electromagnetic and nuclear radii of the nucleus. The difference is estimated. The Fermi motion of the nucleons produces the π-nucleon interaction energies, and, consequently, a smoothing of the mean π-bound nucleon total cross section $\bar{\sigma}$ (which is related to the optical potential) in the π-Δ resonance region. Good agreement is obtained between the experimental results and the theoretical predictions from the known π-nucleon interaction. Some estimates on the elastic differential π-He cross sections are given. (auth)

8111 POLARIZATION OF DIRECT PHOTONUCLEONS FROM DEFORMED NUCLEI, REACTION $^9Be(\gamma,n)^8Be$. I. GENERAL DISCUSSION OF SEVERAL MODELS. Boffi, S. (Univ., Pavia); Sawicki, J.; Scacciatelli, E. Nuovo Cimento (10), 40B: 1-27(Nov. 11, 1965).

General formulas for the differential cross section and photonucleon transverse polarization are given for the (γ,n) or (γ,p) reaction for odd-A strongly deformed nuclei. Four models are considered: the model of Kowalska in which the single photonucleon state is assumed to be spherical and independent of the rotational motion of the residual nucleus, the Bohr-Mottelson adiabatic model with the Nilsson intrinsic wave functions, the model of the generator-projected wave functions and the α-particle model in the particular case of ^9Be. This special case is discussed in terms of all these four models. (auth)

8112 QUASI-FREE SCATTERING FROM α-CLUSTERS. Jackson, D. F. (Battersea Coll. of Tech., London). Nuovo Cimento (10), 40B: 109-17(Nov. 11, 1965).

The process of emission of α clusters by quasifree scattering in medium and heavy nuclei is discussed. It is suggested that the most advantageous arrangement for investigating this reaction with high-energy particles is a nonsymmetric arrangement in which the momentum transfer is small, while for medium-energy projectiles a different nonsymmetric experiment is more suitable. (auth)

8113 CLASSICAL PHASE-SPACE INTEGRAL IN THE STATISTICAL MODEL WITH ANGULAR-MOMENTUM CONSERVATION. Kotanski, A. (Jagiellonian Univ., Krakow); Zalewski, K. Nuovo Cimento (10), 40B: 134-9 (Nov. 11, 1965).

The classical nonrelativistic phase-space integral of the statistical model of multiple production is evaluated by the steepest descent method. The conservation laws for energy-momentum, angular momentum, and center-of-mass position are taken into account. Explicit formulas for the first (thermodynamical) and second approximations are given. The corresponding relativistic phase-space integral diverges for a gaussian cut-off and a sharper cut-off must be applied in this case. (auth)

8114 CHARGED PHOTOPARTICLES FROM ^6Li. Manuzio, G.; Malvano, R.; Ricco, G.; Sanzone, M. (Univ., Geneva). Nuovo Cimento (10), 40B: 300-8(Nov. 11, 1965).

The proton, deuteron, and triton spectra from the photodisintegration of ^{6}Li were measured. The experimental results are confronted with the available theoretical predictions. The deuteron spectrum shows a strong disagreement with calculations performed with an α + d peripheral model. This is also confirmed by a relatively high cross section of the ^{6}Li(γ,^{3}He)^{3}H reaction. (auth)

8115 NEUTRON-PROTON RESIDUAL INTERACTION IN ODD-ODD DEFORMED NUCLEI. Nunberg, P.; Prosperi, D. (Centro Studi Nucleari della Casaccia, Rome). Nuovo Cimento (10), 40B: 318-21(Nov. 11, 1965).

An attempt is made to fit experimental data on odd-odd deformed nuclei, using a model nucleus of an even-even rotating core and two unpaired nucleons interacting via a residual force and having Nilsson orbitals as wave functions. Some separations of states of spin I = K± and some shifts between odd and even spin level in K = 0 bands are fitted, in order to fix the strength of Barlett's, Majorana's, Heisenberg's, and Wigner's forces in the hamiltonian for the residual interaction. (M.J.T.)

8116 ON POSSIBLE M1-M3 MULTIPOLE MIXTURES. Ramaswamy, M. K. (The Ohio State Univ., Columbus). Nuovo Cimento (10), 40B: 439-40(Dec. 11, 1965).

The possibility of interpreting the angular correlation data for 3-2-0 gamma cascades in the deformed rare-earth region in terms of M1-M3 admixture for the K-forbidden 3^{+}-2^{+} M1 transition is explored. Results of the analysis are given for ^{152}Sm, ^{154}Gd, ^{168}Er, ^{172}Yb, ^{182}W, and ^{192}Pt. No definite evidence of an M1-M3 multipole mixture is found, and all data can be interpreted in terms of δ(M1-M2) alone. (M.J.T.)

8117 γ-n REACTIONS IN ^{7}Li. Wataghin, A.; Scotto, M.; Paoli, G. (Univ., Genova). Nuovo Cimento (10), 40B: 441-2(Dec. 11, 1965).

The energy spectrum of photoneutrons emitted at 90° with respect to the incident beam was determined for bremsstrahlung reactions with ^{7}Li at 15 Mev maximum energy, by measuring the ranges of recoil proton tracks in nuclear emulsions. Energy levels of excited states of ^{7}Li were derived from the peaks in the spectrum by assuming that the transitions are from ^{7}Li resonant excited states to the ^{6}Li ground state. (M.J.T.)

8118 THE PRESENT STATE OF NUCLEAR THEORY. Arima, Akito (Tokyo Univ.). Oyo Butsuri, 18: 258-66 (May 1963). (In Japanese).

Beginning with explanation that elucidation of a physical phenomenon requires three points of view: to know nature of the fundamental forces ruling it, to know the laws ruling it and to deduce it from the forces and laws, it is stated that, in nuclear problems the two-body force has been known though imperfectly, but many-body force is nearly unknown at present and suggested that non-relativistic quantum mechanics will suffice with present experimental accuracy. Next, the phenomenalistic models—shell model, coordinate model, collective motion model etc.—are outlined. While emphasized that many present works are focused on quantification of these models and in this direction nuclear study is making a rapid progress, so confusion between the end of the qualitative stage of study with the end of study itself is only a short-sighted view to be avoided, searching out unknown quality of nucleus is pointed out to be as well necessary at the cost of experimental accuracy, and as study of reactions is less accurate than that of structure, powerful development in the field of reactions is suggested to lead to discovery of new quality of nucleus. For example, "heavy ion reactions" due to accelerated ^{6}Li, ^{14}N, ^{16}O, etc., and nuclear reactions due to electrons, K, π, μ-mesons and Λ-particles, that is, due to the particles except nucleons and nuclei, for instance, nature of the complex system formed from Λ-capture by right nucleus called hyperfragment and μ-meson capture and decay are given as future problems. Further it is added that by using nuclear knowledge promotion of research for more larger groups than ordinary nuclei, namely for such problems as evolution of star, white dwarf star, and nascent neutron gas in cosmos is also necessary. (NSA of Japan)

8119 INTERPRETATION OF THE ANISOTROPY OF α PARTICLE EMISSION FROM A MONOCRYSTALLINE SOURCE. Oen, O. S. (Oak Ridge National Lab., Tenn.). Phys. Lett., 19: 358-9(Nov. 15, 1965). (ORNL-P-1586).

The results of Domeij and Bjorkqvist (Physics Letters 14, 127 (1965)), on the anisotropy in alpha particle emission from a monocrystalline source are interpreted quantitatively. For this interpretation a model is used which assumes that the alpha-active nuclei are substitutionally located at lattice sites. A curve is given showing the comparison of theory with the experimental data points for 5.49-Mev alpha particles emitted from radon-222 ions embedded in a tungsten single crystal. (J.F.P.)

8120 THE EFFECT OF NUCLEAR STRUCTURE ON THE HIGH-ENERGY (p,pn) REACTION WITH ^{58}Ni. Karol, P. J.; Miller, J. M. (Columbia Univ., New York). Phys. Lett., 19: 389-91(Nov. 15, 1965). (CU-1019-48).

The prediction that the anomalously low cross section for the (p,pn) reaction with ^{58}Ni is accompanied by an anomalously large value of the cross sections for one or more of the slightly more complicated reactions that can occur is investigated. In order to show what is meant by "anomalously large", the cross sections for various simple reactions with ^{58}Ni were compared with those for ^{64}Zn which, with its cross section of 56.6 mb for the (p,pn) reaction, is taken as representing normal behavior. Each of the targets was irradiated with 370-Mev protons, and the measured cross sections for the corresponding reactions are given. It is seen not only that the low (p,pn) cross section for ^{58}Ni is not accompanied by an increase in the cross section for slightly more complicated reactions, but that all the cross sections for simple reactions that were measured with ^{58}Ni are smaller than the corresponding measurements with ^{64}Zn. It is concluded that the cross section of the direct (p,pn) event itself is a cause of the anomalously low cross section with ^{58}Ni, irrespective of the residual excitation energy. (J.F.P.)

8121 CHARGE RADIUS OF THE ALPHA PARTICLE MEASURED BY LOW ENERGY ELECTRON SCATTERING. Frank, H.; Haas, D.; Prange, H. (Technische Hochschule, Darmstadt, Ger.). Phys. Lett., 19: 391-2(Nov. 15, 1965).

The elastic electron scattering cross section of ^{4}He relative to that of ^{1}H was measured under identical conditions. A gas target containing helium, hydrogen, or a mixture of both gases was used. The electron energy was varied between 35 and 60 Mev. A curve showing the charge form factor of the alpha particle as defined by the Born approximation is given. The experimental values include small corrections resulting from phase shift calculations. The rms charge radius was found to be $\langle r^{2}\rangle^{1/2}$ = 1.63 ± 0.064 fm. (J.F.P.)

8122 VIBRATIONS AND STRENGTH FUNCTIONS IN ^{37}Ar. Lande, A. (Univ. of California, Berkeley). Phys. Lett., 19: 392-3(Nov. 15, 1965). (UCRL-16304).

A one-parameter model is considered for ^{37}Ar. The important features of this model are outlined. It is assumed that ^{37}Ar may be described in terms of coupling between quadrupole oscillations of the even core and a neutron in the nearby empty single particle levels. Excitation energies and spectroscopic factors for (d,p) stripping into ^{37}Ar are shown. These include previous experimental results and also results from the vibrational-core plus single-particle model with a coupling strength of 0.60 Mev. (J.F.P.)

8123 DIPOLE PHOTOEFFECTS IN ^{16}O. [PART] II. Weiss, M. S. (Northeastern Univ., Boston). Phys. Lett., 19: 393-6(Nov. 15, 1965).

The results of a calculation which remove many of the approximations in a previous continuum extension of the conventional particle-hole model and qualitative results applicable to the ^{16}O(γ,n) reaction are presented. Quantitative results directly comparable to experiment are found.

The differences are noted, but the formalism is not redescribed. Calculations of E1 $^{16}O(\gamma,n)$ for a well radius of 4.2 fm are shown. While the model contains many simplifying assumptions, areas of gross deviations of experiment from it probably reflect other multipolarities and (or) the necessity for inclusion of more complex configurations. (J.F.P.)

8124 LOCATION OF THE p-SHELL HOLE STATES IN MASS 15 NUCLEI. Warburton, E. K. (Brookhaven National Lab., Upton, N. Y.); Parker, P. D.; Donovan, P. F. Phys. Lett., 19: 397-8(Nov. 15, 1965). (BNL-9540).

Evidence is presented from the $^{16}O(He\text{-}3,\alpha)^{15}O$ reaction which is in agreement with the (p,d) results. This indicates that the ^{15}O 6.18-Mev state contains the bulk of the p $3/2$-hole strength in ^{15}O and that there is no appreciable ($\lesssim 10\%$) component of this state at excitation energies between 6.5 and 13 Mev in oxygen-15. Measurements were made using a 31-Mev beam. The helium-4 spectrum obtained is shown. The cross sections for all the groups observed were found to be peaked sharply forward, consistent with a direct pickup description for the (He-3,α) reaction mechanism as would be expected at the beam energy used, at least at these forward angles. There are no levels between 6.5 and 13 Mev excitation which have cross sections greater than $1/4$ of that for the 6.18-Mev level, and the cross section for formation of the 8.98-Mev level is less than $1/10$ of that for the 6.18-Mev level. (J.F.P.)

8125 ISOBARIC SPLITTING OF DIPOLE STATES IN NUCLEI. Fallieros, S.; Goulard, B.; Venter, R. H. (Bartol Research Foundation, Swarthmore, Pa.). Phys. Lett., 19: 398-400(Nov. 15, 1965).

The relation between two familiar modes of nuclear excitation, the dipole modes and the analog excitations, is studied, since conventional methods describing such states are not identical. The analog levels are known to involve the temporary transformation of an excited proton into an equivalent neutron accompanied by the creation of a proton-particle-neutron-hole monopole excitation in the neutron-excess shells. This suggests the significance of the coupling of a particle-hole pair to a specific four-quasiparticle excitation, the consequences of which are summarized. (J.F.P.)

8126 NUCLEAR BINDING ENERGY AND QUADRUPOLE-QUADRUPOLE INTERACTION. Arima, A.; Nomura, M.; Kawarada, H. (Tokyo Univ.). Phys. Lett., 19: 400-3(Nov. 15, 1965).

It is shown that the quadrupole-quadrupole interaction must be attractive because of the repulsive n^2 term, where n is the number of nucleons outside the closed shell. The pure configuration j^n and the pure seniority coupling scheme are used. Excitation energy of states with spin two is shown. (J.F.P.)

8127 ALPHA DECAY TO VIBRATIONAL STATES. Sandulescu, A. (Research Inst. for Theoretical Physics, Helsinki); Dumitrescu, O. Phys. Lett., 19: 404-7(Nov. 15, 1965).

A study is made of the influence on alpha transitions of long range correlations arising from the residual interaction of the quadrupole and octupole type, that is the alpha transitions to quadrupole and octupole vibrational levels. The hindrance factors were calculated for alpha transitions to quadrupole vibrational states 0^+ and 2^+ and to octupole vibrational states 1^- in the transuranium region, and these are shown. Also the A coefficients, superfluid weights, and the reduced width amplitudes for collective and ground states were calculated. (J.F.P.)

8128 ON THE SHELL-MODEL TREATMENT OF NUCLEAR REACTIONS. Mahaux, C. (Univ., Liege); Weidenmueller, H. A. Phys. Lett., 19: 408-10(Nov. 15, 1965).

A clarification is made of the relation between the work by Danos and Greiner (Phys. Rev. 138, B93 (1965)), who proposed a new method to calculate the resonance energies and widths, based upon the R-matrix theory of nuclear reactions, and the conditions established in Mahaux (Ann. Phys 32, 259 (1965)). Their approach is elucidated by comparing it with other treatments. (J.F.P.)

8129 POLARIZATION IN THE SCATTERING OF 9.4 Mev PROTONS FROM SILVER. Griffith, J. A. R.; Roman, S. (Birmingham Univ., Eng.). Phys. Lett., 19: 410-12 (Nov. 15, 1965).

The magnitude of the polarization present in the scattering of 9.4-Mev protons by silver is investigated. The polarization of the scattered protons is shown. From the results it is concluded that the nuclear optical model, which fits the elastic scattering differential cross section data for many nuclei at 9.5 Mev very well, also gives a good prediction of the polarization for a heavy nucleus, whereas the total reaction cross section is less well predicted. It is suggested that rather than indicating that a different parameter set is required, this may be evidence that the model is incorrectly estimating the effect of the Coulomb barrier. (J.F.P.)

8130 INTERVAL RULES AND INTENSITY RATIOS IN VIBRATING SPHERICAL NUCLEI. Brink, D. M. (Oxford Univ.); De Toledo Piza, A. F. R.; Kerman, A. K. Phys. Lett., 19: 413-15(Nov. 15, 1965).

A purely phenomenological model containing, in addition to H_0, the most general anharmonic terms up to and including quartic terms, is considered. The useful predictions of this model are calculated. The results of the computation of various properties are given. These results include one-, two-, and three-phonon levels. (J.F.P.)

8131 STUDY OF THE REACTION $^{208}Pb(d,p)^{209}Pb$ AT ENERGIES BELOW THE COULOMB BARRIER. Dost, M.; Hering, W. R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., 19: 488-90(Dec. 1, 1965).

In order to test the validity of the Coulomb-Wave-Born Approximation (CWBA) for the absolute differential cross sections in the analysis of stripping experiments, the reaction $^{208}Pb(d,p)^{209}Pb$ was studied between 7.0 and 10.5 Mev bombarding energies. The dependence of the spectroscopic factors on the normalization constant of the neutron wave function via the variation of the radius constant is shown. Spectroscopic factors extracted from the reaction studied below the Coulomb barrier are given. It is concluded that at incident energies well below the potential barrier, the CWBA gives correct spectroscopic factors to the extent that the right normalization constant of the wave function for the captured particle is known. The radius constant to be used for a local bound state potential of Saxon-Woods form is 1.23–1.25 fm for heavy nuclei. Also the potential radius to be used in CWBA calculations seems to be largely independent of the orbital angular momentum and binding energy of the captured particle. (J.F.P.)

8132 COEXISTENCE OF SHELL MODEL AND DEFORMED STATES IN OXYGEN ISOTOPES. Federman, P.; Talmi, I. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Lett., 19: 490-3(Dec. 1, 1965).

The results obtained by using the approach of effective interactions for levels of oxygen nuclei are reported. This calculation presents a consistent picture accounting for the energies and some other properties of low lying levels in these nuclei. The shell model states are taken to be due to neutrons in the $1d_{5/2}$ and $2s_{1/2}$ orbits. The single neutron energies in these orbits were taken from ^{17}O. In addition to these, intrinsic deformed states are built by raising the two $1p_{1/2}$ protons into Nilsson like orbits in the (s,d) shell. Experimental and calculated energies are listed, as well as the main configuration of the wave functions. The theoretical parameters, the effective matrix elements between the shell model and the deformed states, and wave functions of the J = 0 and J = 2 levels of ^{18}O are each listed. (J.F.P.)

8133 EFFECTIVE INTERACTIONS IN FINITE NUCLEI. Hull, M. H. Jr.; Shakin, C. (Oxford Univ.). Phys. Lett., 19: 506-9(Dec. 1, 1965).

It was shown that a rapidly convergent cluster expansion could be made to treat the correlations due to the hard-core of the two-nucleon potential. A unitary model operator was used to arrive at an Hermitian effective nuclear hamiltonian. The binding of various hole and particle orbits with

respect to the oxygen-16 core were also calculated and are shown. It is concluded that the method can provide a unified treatment, starting from realistic two-nucleon forces, of nuclear correlations, binding energies and nuclear saturation, spin-orbit splittings, and the effective interaction for the nuclear shell model. (J.F.P.)

8134 TIME DEPENDENT HARTREE-FOCK TREATMENT OF THE E1-GIANT RESONANCES IN ^{24}Mg. Bassichis, W. H.; Scheck, F. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Lett., 19: 509-11(Dec. 1, 1965).

The giant resonances are calculated within the framework of the time-dependent Hartree-Fock method, using as a single-particle basis a true self-consistent Hartree-Fock solution for the deformed nucleus. The intrinsic giant resonance energies are shown for magnesium-24. The unperturbed particle-hole states are also shown. It is noted that not only the energies but also the oscillator strengths remain practically unchanged by the inclusion of the B matrix. (J.F.P.)

8135 MEASUREMENT OF 0.1-kev NUCLEAR-STATE WIDTHS IN THE CONTINUUM BY FLUCTUATION AVERAGING. Fessenden, P.; Gibbs, W. R.; Leachman, R. B. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 15: 796-8(Nov. 15, 1965). (LA-DC-7492).

A method of fluctuation averaging is reported that allows the measurement of widths that are orders-of-magnitude smaller than those of previous measurements. The reaction ^{89}Y(p, α_0)^{86}Sr was used, and the differential cross sections were measured at angles of 51 and 129°. In the first measurements, 0.1-kev widths of the compound nucleus ^{90}Zr were measured between 17- and 21-Mev excitation energies. These widths were determined from measurements of the amount that the fluctuations in the cross section are reduced by fluctuation averaging, which results from the resolution significantly exceeding the average width. The decrease in fluctuations from fluctuation averaging results from each cross section measurement being an average over a cross section that fluctuates within the energy resolution of each bombardment. The determination of ^{90}Zr widths is shown. The gross excitation function measured with large energy resolutions and the widths are shown. The measured widths are based on the fluctuations and on fractions of direct reactions determined from comparisons of measured and calculated excitation functions given. (J.F.P.)

8136 ATOMIC-BEAM METHOD FOR THE STUDY OF ISOTOPE SHIFTS. Marrus, Richard; McColm, Douglas (Univ. of California, Berkeley). Phys. Rev. Lett., 15: 813-15(Nov. 22, 1965).

A new method is described for the study of isotope shifts. This method, based on the atomic-beam technique, has the considerable advantage over optical techniques that it can be applied to radioactive nuclei in the presence of large amounts of stable carrier. Therefore, it will make possible an extension of the study of isotope shifts to the large class of radioactive nuclei which can not be practicably studied by any currently existing techniques. As a demonstration the application of this method to a measurement of the ^{133}Cs–^{134m}Cs isotope shift in the $6^2P_{\frac{1}{2}}-6^2S_{\frac{1}{2}}$ transition (D_1 line) is presented. The basic apparatus employed is a conventional atomic-beam apparatus with flop-in magnet geometry. The details and use of this apparatus are described. Curves are given showing the observed signal versus applied voltage for a cesium-133 beam and for a cesium-134m beam. The beam machine can be regarded as a tunable spectrometer for studying the emission profile of the lamp. Since the light is perpendicular to the beam direction, there is no Doppler effect and the resolution of the instrument is the natural linewidth of the transition. (J.F.P.)

8137 STRUCTURAL BASIS OF THE ONSET OF NUCLEAR DEFORMATION AT NEUTRON NUMBER 90. Pauling, Linus (Center for the Study of Democratic Institutions, Santa Barbara, Calif.). Phys. Rev. Lett., 15: 868-70(Nov. 29, 1965).

A simple explanation for the onset of deformation at N = 90 nuclei is provided by the close-packed-spheron theory of nuclear structure. This theory is described, and its applications to this deformation are discussed. This deformation is illustrated according to the theory by showing a two-dimensional representation of a nearly spherical close-packed arrangement of spherons, with one in the inner core, and of an arrangement with prolate deformation, consequent to having two spherons in the inner core. It is concluded that all nuclei showing prolate deformation in the range N = 90 to 120 have a two-spheron inner core, and that it is the geometrical properties of this inner core that is responsible for the deformation. (J.F.P.)

8138 THREE-BODY NUCLEAR REACTIONS. Demortier, G. (Centre de Physique Nucleaire, Louvain, Belg.). Rev. Quest. Sci., 136: 185-96(Apr. 1965). (In French).

The reaction mechanism for the production of two particles is first considered. The detection of charged particles, particularly with semiconductor junctions, is described; the use of multichannel analyzers for determination of kinetic energy by this method is illustrated. The interpretation of a multi-peak spectrum is outlined; several reactions leading to different particles may be the cause, but it is possible to separate different events by use of detectors in series. There remains the possibility of nuclear reactions yielding three particles. The constraints on such a system are discussed; two particles emitted at fixed angles do not have independent energies. They exist on a curve on the energy plane; these curves may be determined for a whole set of angles by means of a computer. Zones of strong and weak interaction are determined; these are compared with sequential (as opposed to instantaneous) formation of three particles in a collision. The determination of the characteristic time in cases of residual interaction is of prime importance in description of these processes. Several possible reactions which might be used as examples of these processes are discussed. (BBB)

8139 CORRELATION OF THE DIRECTIONS OF INTERNAL CONVERSION ELECTRONS IN THE FURRY-SOMMERFELD-MAUE APPROXIMATION. Boldyshev, V. F. (Inst. of Physics and Tech., Academy of Sciences, Kharkov). Ukr. Fiz. Zh., 10: 929-37(Sept. 1965). (In Ukrainian).

The directional correlation of conversion electrons during cascade transitions is determined by the so-called conversion parameters; the knowledge of these correlations may yield information concerning the spin and parity of nuclei. Consequently, the conversion parameters for K-shell conversion during pure multipole transitions are calculated using a special form of the nuclear intermediate state density matrix. The nuclear Coulomb field is taken into account approximately by using the Furry-Sommerfeld-Maue electron wave functions. The procedure is illustrated by a Z = 40 magnetic quadrupole transition calculation. (ATD)

8140 OPTIC MODEL FOR DEUTERONS, TAKING INTO ACCOUNT THE TENSOR SPIN-ORBIT INTERACTION. L'ovshyn, E. B.; Kharchenko, V. F. (Inst. of Physics, Academy of Sciences, Kiev). Ukr. Fiz. Zh., 10: 938-51 (Sept. 1965). (In Ukrainian).

Formulas are derived for the analysis of elastic deuteron scattering based on the optic model taking into account all possible types of spin-orbit interaction and the existence of nondiagonal matrix elements of the optic potential. The experimentally measured quantities (such as the differential cross section, polarization components, and the total reaction cross sections) are all expressed in terms of partial phase shifts. The incident deuteron beam is assumed polarized in an arbitrary manner. (ATD)

8141 ON BOUND STATES OF PARTICLES MOVING IN A NON-LOCAL POTENTIAL. Korolev, A. M. (Inst. of Physics, Academy of Sciences, Kiev). Ukr. Fiz. Zh., 10: 969-76(Sept. 1965). (In Ukrainian).

The problem of bound states of particles moving in a potential well is investigated by choosing the nonlocal potential in such a form that it takes into account the correlation properties of the numerous particles and at the same time permits an exact solution of a simplified equation. The Yamaguchi potential with separated variables leaves the angular momentum preserved and leads to a comparatively simple solution of the Schroedinger equation. Expressions are given for the eigenfunctions for two particular forms of the Yamaguchi functions. Except for special values of pertinent parameters, the energy eigenvalues are obtained by numerical calculation. The energy level sequence for particles with different angular momentum values is also discussed. The appendix contains the derivation of the Green's function of the particle (for the potential well case) used for the solution of the integro-differential equation. (ATD)

8142 THE MECHANISM OF THE $^{29}Si(d,\alpha)^{27}Al$ REACTION. Denisov, A. E.; Kolalis, R. P.; Nemilov, Yu. A.; Sadkovski, V. S.; Teterin, E. D.; Gridnev, K. A. Yadern. Fiz., 2: 663-5(Oct. 1965). (In Russian).

The angular distributions in the reaction $^{29}Si(d,\alpha)$ were measured. The deuteron energy of the cyclotron beam was 5.5 to 5.8 Mev. The α particles were detected by means of a semiconductor detector with the 1% resolution. The angular distributions are almost symmetrical with respect to 90° and depend weakly upon the deuteron energy. The integral cross section appears to be proportional to the factor $2I + 1$ for $I \leq 5/2$, where I is the spin of the given level of final nucleus. The similarity of the (d,α) reactions on ^{29}Si and ^{27}Al is pointed out. The reaction $^{29}Si(d,\alpha)^{27}Al$ seems to proceed by the compound-nucleus mechanism in the given energy region. (auth)

8143 TERNARY FISSION OF ^{235}U BY RESONANCE NEUTRONS. Kvitek, I.; Popov, Yu. P.; Ryabov, Yu. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 2: 677-81(Oct. 1965). (In Russian).

Measurements of ternary fission of ^{235}U by 0.1 to 50 ev neutrons were carried out on the JINR pulsed fast reactor, using the time-of-flight method with resolution 0.6 μsec/m. In contrast to other investigations concerning the ternary fission of ^{235}U in the resonance neutron region, the ternary fission event was identified by the coincidence of one of the fission products with a light long-range particle. The results imply that no significant variations from one resonance to another exists for the ratio of the ternary and binary fission cross sections. Small variations (20%) of a number of resonances are correlated with previous results. (auth)

8144 CROSS SECTIONS FOR THE FISSION OF ^{181}Ta, Re, Pt, ^{197}Au, Pb, ^{209}Bi, ^{232}Th, ^{235}U, AND ^{238}U BY PROTONS WITH ENERGIES 150 TO 660 Mev. Konshin, V. A.; Matusevich, E. S.; Regushevskii, V. I. Yadern. Fiz., 2: 682-6 (Oct. 1965). (In Russian).

The cross sections σ_f were obtained for the fission of nine elements, in the region Z^2/A between 29.4 and 36, by protons with energies of 150 to 660 Mev. The measurements were performed on the internal and external proton beams of the JINR synchrocyclotron. The number of fission events was determined from the tracks left by the fission products in glass. The standard cross section for the fission of ^{238}U by 280-Mev protons, equal to $(1.46 + 0.06) \cdot 10^{-24}$ cm^2 was used. (auth)

8145 STUDY OF THE REACTIONS $p + {}^7Li \rightarrow \pi + {}^8Li$ OR ^8B AND $p + {}^7Li \rightarrow \alpha + \alpha$ AT THE PROTON ENERGY OF 660 Mev. Kuz'min, V. N.; Yakovlev, R. M. Yadern. Fiz., 2: 687-90(Oct. 1965). (In Russian).

The cross section of the reaction $p + {}^7Li \rightarrow \{{}^{\pi^+}_{\pi^-} + {}^{8}_{8}{}^{Li}_{B}\}$ at the cms angle of the outgoing pion of 25° was measured. Measurement of the reaction $p + {}^7Li \rightarrow \alpha + \alpha$ made it possible to estimate the upper bound for the cross section of the formation of the compound nucleus at the proton energy of 660 Mev. (auth)

8146 INVESTIGATION OF THE $\beta\gamma$ POLARIZATION CORRELATION IN THE β DECAY OF ^{144}Pr AND ^{152m}Eu. Lobashov, V. M.; Nazarenko, V. A.; Kharkevich, G. J. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 2: 777-82(Nov. 1965). (In Russian).

Measurements were made of the beta-gamma polarization correlation for the allowed beta decay of ^{144}Pr and ^{152m}Eu. Electrons with selected energies were separated by means of the magnetic lens spectrometer. The circular polarization of the gamma quanta was measured by the transmission method. (auth)

8147 DECAY OF ^{161}Er. Gromov, K. Ya.; Zhelev, Zh. T.; Zvol'ska, V.; Kalinnikov, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 2: 783-93(Nov. 1965). (In Russian).

The positron radiation of ^{161}Er ($E_0 = 820 \pm 40$ kev) was observed by means of a triplefocusing magnetic spectrometer. Results concerning the conversion electron spectrum are presented. Conclusions are drawn on the multipolarities of some transitions. A decay scheme of $^{161}Er \rightarrow {}^{161}Ho$ is proposed. The 1897- and 1943-kev levels are interpreted a three-quasi-particle states. (auth)

8148 LIFETIME OF THE 1.46-Mev LEVEL OF ^{40}Ar. Gusinskii, G. M.; Erokhina, K. I.; Lemberg, I. Kh. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 2: 794-5(Nov. 1965). (In Russian).

The reduced probability of the electric quadrupole transition B(E2) from the ground state of ^{40}Ar to the first excited level was determined by investigating the Coulomb excitation of this level. The 1.46-Mev level was excited by bombarding aluminum with 48-Mev argon ions. From the known relation between B(E2) and the lifetime of the levels of even-even nuclei with spin and parity 2^+, it was possible to calculate the lifetime. (auth)

8149 OCTUPOLE MAGNETIC MOMENTS OF SPHERICAL NUCLEI. Troitskii, M. A. Yadern. Fiz., 2: 796-80(Nov. 1965). (In Russian).

The equation for the octupole magnetic moments is obtained using the quasiparticle interaction method. A comparison with experiments is made. (auth)

8150 THE ALPHA-PARTICLE MODEL AND ELECTRON SCATTERING. Inopin, E. V.; Kresnin, A. A.; Tishchenko, B. I. Yadern. Fiz., 2: 802-9(Nov. 1965). (In Russian).

The scattering of electrons by 1p- and 2s–1d-shell nuclei is studied on the basis of the alpha-particle model. General expressions for the cross sections of elastic and inelastic scattering are obtained. The results are compared with experimental data. The agreement is quite satisfactory, but for final conclusions on the validity of the approach in the region of the 2s–1d-shell more detailed experimental data are necessary. It is shown that the radii of alpha clusters in nuclei are larger than the radius of a free alpha-particle. This difference increases as the number of nucleons in a nucleus grows. (auth)

8151 SCATTERING WITH THE EXCITATION OF THE COLLECTIVE NUCLEAR LEVELS IN THE OPTICAL MODEL. Drozdov, S. I. Yadern. Fiz., 2: 810-22(Nov. 1965). (In Russian).

Using the optical model, the principal equations describing the scattering of particles by nuclei with the excitation of the lower rotational or vibrational nuclear levels are derived. The results of calculations in the adiabatic approximation are given. (auth)

8152 ANGULAR DISTRIBUTION OF γ QUANTA PRODUCED IN THE INELASTIC SCATTERING OF NEUTRONS ON IRON. Broder, D. L.; Klenov, V. I.; Lashuk, A. I.; Sadokhin, I. P. Yadern. Fiz., 2: 823-5(Nov. 1965). (In Russian).

The angular distributions of gamma quanta with energies of 0.84, 1.23, 1.41 Mev, from the inelastic scattering of neutrons with energies of 1.2, 2.01 and 2.61 Mev on ^{56}Fe and ^{54}F nuclei were measured. The results were compared

with theoretical calculations according to the Satchler formula for gamma quanta with energies of 0.84 and 1.41 Mev. (auth)

8153 INELASTIC SCATTERING OF 14-Mev NEUTRONS AND THE NUCLEAR LEVEL DENSITY. Anufrienko, V. B.; Devkin, B. V.; Kotel'nikova, G. V.; Kulabukhov, Yu. S.; Lovchikova, G. N.; Sal'nikov, O. A.; Timokhin, L. A.; Trubnikov, V. R.; Fetisov, N. I. Yadern. Fiz., 2: 826-38(Nov. 1965). (In Russian).

The spectra of secondary neutrons from the inelastic scattering of 14-Mev neutrons on the nuclei of 23 elements with A = 12 to 209 were measured by the time-of-flight method. Nuclear temperatures were determined, together with level density coefficients. (D.C.W.)

8154 INVESTIGATION OF (d,α) REACTIONS ON ^{16}O, ^{27}Al AND ^{28}Si NUCLEI FOR DEUTERONS WITH THE ENERGIES 5.5 TO 6.7 Mev. Sadkovskii, V. S.; Teterin, E. D.; Gridnev, K. A.; Denisov, A. E.; Kolalis, R. P.; Nemilov, Y. A. Yadern. Fiz., 2: 843-52(Nov. 1965). (In Russian).

The angular distributions in (d,α) reactions on ^{16}O, ^{27}Al, and ^{28}Si at 5.5 to 6.7 Mev were measured. The statistical mechanism of the reaction, leading to a symmetrical angular distribution with respect to the angle 90° (non-monochromatic cyclotron beam), was confirmed for ^{27}Al. The similarity with the reaction $^{29}Si(d,\alpha)^{27}Al$ is noted. The contribution of direct processes becomes important for the alpha-particle nuclei ^{16}O and ^{28}Si, as well as the compound nucleus contribution. The fact that the integral cross sections are constant (within the experimental errors) with respect to the deuteron energy is of special interest. (auth)

8155 ON THE THEORY OF MUON CAPTURE. Bunatyan, G. G. (Moscow Inst. of Physics Engineering). Yadern. Fiz., 2: 868-77(Nov. 1965). (In Russian).

The total muon capture rates are calculated for spherical nuclei in the shell model approximation. The strong correlation between nucleons is taken into account on the basis of the theory of finite Fermi systems. The numerical results for ^{16}O and ^{40}Ca show that this method leads to good agreement with the experimental values. (auth)

8156 RADIATIVE PAIR PRODUCTION BY PHOTONS IN THE FIELD OF A NUCLEUS. Volkovyskii, R. Yu. (Obraztsov Inst. of Railroad Transportation Engineers, Leningrad). Yadern. Fiz., 2: 878-81(Nov. 1965). (In Russian).

The cross section for the creation of an electron pair and a photon by a photon in the field of a nucleus is calculated using the Weizsacker-Williams method and taking screening into account. The energy of the secondary photon is taken to be small in comparison with the energy of the initial photon. (D.C.W.)

8157 THE DECAY ENERGY OF ^{55}Cr. Koehler, W.; Knopf, K. (Technische Hochschule, Munich). Z. Naturforsch., 20a: 969-70(July 1965). (In German).

The total β energy of ^{55}Cr and ^{52}V was measured in various strong absorbers. The absorption measurements for both elements were made both on the pure elements and also on the oxides. Neither element showed any variation in the form of the absorption curves for the 2 forms used. The total β energy of ^{55}Cr was determined as $E_\beta = 2.494 \pm 0.025$ Mev. The β energy of ^{52}V was $E_\beta = 2.47 \pm 0.03$ Mev. (J.S.R.)

8158 STUDY OF ^{171}Er DECAY BY MEANS OF AN ELECTRON-GAMMA COINCIDENCE TECHNIQUE. El-Nesr, M. S.; El-Aassar, M. R. (Atomic Energy Establishment, Cairo). Z. Phys., 189: 138-50(1966).

The decay scheme of ^{171}Er was investigated by means of an electron-gamma coincidence spectrometer and a scintillation spectrometer with a transistorized RIDL-400 channel analyzer. A careful unfolding of the high energy region of the gamma spectrum revealed the presence of photopeaks at energies of approximately 371, 404, 543, 572, 618, 675, 738, 796, 869, 910, and 962 kev. The existence of 32 transitions in ^{171}Tm was confirmed. Also, it is proved that the 277, 362 kev transitions are in coincidence with the 210 kev and that the 175 kev transition is in coincidence with the 86 kev transition. From coincidence and single counting rates the following K-conversion coefficients of the 111, 116, 124, 296, and 308 kev transitions were determined to be: $\alpha_K(111) = 1.561 \pm 0.062$, $\alpha_K(116) = 0.699 \pm 0.035$, $\alpha_K(124) = 0.608 \pm 0.024$, $\alpha_K(296) = 0.0197 \pm 0.0010$, $\alpha_K(308) = 0.0183 \pm 0.0009$, which give the 116, 124 kev transitions an electric quadrupole character; the 111 kev transition a magnetic dipole character with E2/M1 equal 0.4528; and the 296, 308 kev transitions an electric dipole character with M2/E1 equal 0.0058 and 0.0071 respectively. (auth)

8159 NUCLEAR FORCES. Brink, D. M. Selected Readings in Physics. New York, Pergamon Press, Inc., 1965. 243p. $1.95.

An investigation is made of the development of the theories of nuclear forces, and the present state of knowledge is described. Original papers which established the foundations of current theories of nuclear forces are presented. The topics considered include nuclear physics in 1932, theories of Heisenberg, Wigner and Majorana, the two-body problem, charge symmetry and independence, nucleon-nucleon scattering at high energies, and the meson theory of nuclear forces. (J.F.P.)

8160 A DIFFRACTION MODEL FOR DIRECT NUCLEAR REACTIONS AND A STUDY OF THE TWO-NUCLEON CORRELATION FUNCTION [Thesis]. Yu, David Un-ling. Seattle, Univ. of Washington, 1965. 233p.

A simple diffraction model is developed for analyzing direct nuclear reactions in which both the incident and detected particles are strongly absorbed by their respective nuclei. The model has the advantage of "Anschaulichkeit." Furthermore, it is able to explain the strong forward peaking often observed in the angular distributions of the reaction products and the preferential excitation of relatively high spin states in reactions where the outgoing momentum differs considerably from the incident momentum. Although the model is chiefly applicable in forward directions, it has also been extended to large angles. The limitations and assumptions of the model are investigated. A method for studying the two-nucleon correlation function in nuclei is considered. The proposed method consists of the ejection of two nucleons by a high-energy strongly interacting particle. By measuring the angular and energy correlation of the two ejected nucleons in coincidence with the scattered projectile, a direct measure of the correlation function appears to be possible. These conclusions are based on a potential-type treatment. The effects that complicate and might invalidate the conclusion are considered. Feasibility of the experiment is discussed. (Disseration Abstr.)

8161 EFFECT OF ANTISYMMETRIZATION ON STRIPPING REACTIONS USING DISTORTED WAVES [Thesis]. Strobel, George Lewis. Los Angeles, Univ. of Southern California, 1965. 147p.

In an antisymmetrized formulation of a (d,p) stripping reaction it is possible for the proton in the final state to have originated in either the target or in the incident deuteron. The possibility of the proton coming from the target is represented by an exchange term in the antisymmetrized transition amplitude. The effect on the differential cross section of various stripping reactions of including such an exchange term is studied. Only the neutron-proton interaction (stripping) has been included in previous distorted wave calculations of the differential cross section. Here the deuteron and target-proton interaction (knock out) is also included in the calculation. Calculation of the differential cross section for the reaction $^{12}C(d,p)^{13}C$ using plane waves indicated that stripping and knock out contributed about equally to the cross section. When the calculation was repeated using distorted waves, the stripping contribution was about 100 times the knock out contribution. The plane wave calculation had assumed a surface reaction mechanism not assumed in the distorted wave calculation. The $^{32}S(d,p)^{33}S$ reaction differential cross section was calculated using distorted waves. Including the knock-out contribution to the cross section noticeably improves

the fit to the experimental cross section. For the $^{10}B(d,p)^{11}B$ first excited state reaction the stripping contribution is zero due to an angular momentum selection rule. For scattering angles greater than 30°, the calculated differential cross section fit the experimental differential cross section fairly well using optical model potential parameters which had best fit the $^{10}B(d,p)^{11}B$ ground state stripping reaction. (A.G.W.)

8162 A STUDY OF THE DIRECT NUCLEAR KNOCK-OUT REACTION MODEL [Thesis]. McRary III, John Walter. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1964. 129p.

The theory of direct nuclear knock-out reactions involving the exchange of two fermion clusters is developed using the distorted wave Born approximation (DWBA). Spin-dependent distortions and a finite range direct interaction are included in the formalism, but kinematical considerations are neglected by assuming an infinitely heavy core for the target and residual nuclei. Explicit expressions are obtained for the angular distribution, the total cross section, the polarization of the emitted particles, and the angular correlation function for possible de-excitation γ radiation from the residual nucleus in the case where the incident beam is unpolarized. Then the formalism is extended to include the experimentally feasible possibility that the incident beam is polarized. The $^{13}C(\alpha,n)^{16}O$ reaction is analyzed at 12.8, 14.1, and 22.5 Mev on the assumption that the reaction proceeds via a knock-out mechanism. Distorted wave Born approximation calculations are carried out using both a finite range (Gaussian) and zero-range direct interactions. Harmonic oscillator and square well eigenfunctions are examined as possible phenomenological solutions to the spectroscopic problem of neutron and α-particle wave functions. The importance of the nuclear interior is assessed by introducing a radial cut-off, and it is found that the interior nuclear wave functions used in this study do give an appreciable contribution to the transition matrix overlap integrals. The formalism is applied to the ^{29}S (tn) ^{31}P reaction at 10 Mev and the angular distribution is predicted for comparison with future experimental data. (Dissertation Abstr.)

8163 MEASUREMENTS OF THE ABSORPTION CROSS SECTION OF LIQUID HYDROGEN BY THE PULSED NEUTRON TECHNIQUE [Thesis]. Bryan, Frederick Allen Jr. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1965. 84p.

The absorption cross section of liquid hydrogen was measured for hydrogen in high parahydrogen concentrations and in high orthohydrogen concentrations. The decay constants of thermal neutrons in systems of well defined geometry were measured as a function of buckling. From a least squares fit of the experimental data, quantitative information was obtained regarding the absorption cross section of liquid hydrogen. Experimental results indicate that there is a molecular structure effect in the capture cross section of hydrogen. Calculations based on the 2200 m/sec value of the absorption cross section of hydrogen (σ = 0.332 b/atom) give an exponential decay constant, λ_0, for neutrons absorbed from an infinite medium of liquid hydrogen of 0.310×10^4 sec^{-1}. The measurements show that for pure parahydrogen the infinite medium decay constant is $\lambda_0^p = (0.187 \pm 0.024) \times 10^4$ sec^{-1}; for pure orthohydrogen, the infinite medium decay constant is found to be $\lambda_0^o = (0.587 \pm 0.049) \times 10^4$ sec^{-1}. These decay constants yield the neutron absorption cross sections of the protons in ortho- and parahydrogen. At energy kT, T = 20°K, the measured microscopic absorption cross sections are 2.46 ± 0.21 barns/atom for pure orthohydrogen and 0.784 ± 0.099 barns/atom for pure parahydrogen. The transport mean free paths and the mean velocity of neutrons in two widely different ortho-parahydrogen mixtures were also determined. (Dissertation Abstr.)

8164 NMR LINE NARROWING BY A ROTATING R. F. FIELD [Thesis]. Lee, Moses. University Park, Pa., Pennsylvania State Univ., 1964. 116p.

A new method of line narrowing in nuclear magnetic resonance is studied experimentally and theoretically. This method is that of Redfield's rotary saturation experiment on a tightly coupled spin system placed in a large d-c field and a saturating r-f field. The nutating magnetization component $M_z(t)$ projected along the d-c field is measured using the pulse technique. The sample used was a single crystal of CaF_2. The envelope K(t) of the oscillation in $M_z(t)$ is shown to be the Fourier transform of the Redfield's rotary saturation line. The second moments of the rotary saturation line are obtained from K(t) using a least squares fit to the data. Measurements were made at various values of the parameter $\lambda_0(\theta) = \frac{1}{2}(3\cos^2\theta - 1)$ and the effective magnetic field H_e. The second moments are measured at $\lambda_0(\theta) = 0$ as a function of H_e for two orientations of the single crystal. It is found that the residual second moment at $\lambda_0(\theta) = 0$ is due to the non-secular term of the dipolar interaction in the rotating reference frame. There is also a smaller contribution from the inhomogeneity in the r-f field. The residual second moment at $\lambda_0(\theta) = 0$ is found to be inversely proportional to the square of the effective magnetic field. From the contribution of the field inhomogeneity to the second moment, the field inhomogeneity is estimated. The second moment due to the non-secular term is calculated using two methods. The calculated second moment at $\lambda_0(\theta) = 0$ agreed with the experimentally measured value within 20%. With the present method it was possible to narrow the width of the rotary saturation line by a factor of ten at most. It is also found that at $\lambda_0(\theta) = 0$ K(t) approaches exponential form for long t. The time constant of the exponential part of K(t) is defined as a spin-spin relaxation time T_2. At $\lambda_0(\theta) = 0$ T_2 is found to arise from the non-secular term of the dipolar interaction in the rotating reference frame and also from the inhomogeneity in the d-c and the r-f magnetic fields. (Dissertation Abstr.)

8165 NEUTRON POLARIZATION MEASUREMENTS USING A LIQUID HELIUM, TIME-OF-FLIGHT, COINCIDENCE POLARIMETER [Thesis]. Miller, Thomas Gill. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1965. 74p.

A liquid-helium, time-of-flight coincidence polarimeter was developed to measure neutron polarization. The polarizer analyzer is liquid helium in a specially constructed cryostat. Energy selection is accomplished by time-of-flight techniques and the background is reduced to a negligible amount by requiring fast coincidence between the polarizer analyzer and the side counters. The counts from both side counters are recorded simultaneously in a 400-channel analyzer by splitting the memory of the analyzer. Measurement of the neutron polarization for the $D(d,n)^3He$ reaction is made using the polarimeter for deuteron bombarding energies between 1.5 and 1.9 Mev at a laboratory angle of 35 degrees. The polarization is a slowly vary ng function of deuteron energy. The polarization varies from −16.5% at 1.5 Mev to −21.6% at 1.9 Mev. (Dissertation Abstr.)

8166 DECAY OF ^{102}Ag [Thesis]. Charoenkwan, Prasit. Los Angeles, Univ. of California, 1965. 114p.

^{102}Ag was produced following the bombardment of 14- to 16-Mev protons from the UCLA 50-Mev Spiral Ridge Cyclotron. Beta and gamma radiations and K-capture were observed, and the half life of ^{102}Ag was remeasured to be 13 ± 0.4 min. The positron spectrum of ^{102}Ag was examined using magnetic lens and solid state spectrometers. The 2.26- and 1.90-Mev components were found. With the techniques of beta-gamma coincidence, 3 weak beta groups were found. The energies and intensities of the gamma rays were measured with scintillation and lithium-drifted germanium semiconductor detectors. Measurements of the x-ray intensity indicate a large amount of K-capture. On the basis of gamma-gamma-gamma, gamma-gamma, beta-gamma, and x ray-gamma coincidence measurements, the level scheme is proposed. A new 7.7 ± 0.5 min isomer was found with the same production characteristics as ^{102}Ag. Magnetic spectrometer measurements gave positron endpoint energies from this isomeric state at 4.06 ± 0.02, 3.37 ± 0.10, and 3.07 ± 0.14 Mev. Measurements with the

plastic scintillator also indicated the presence of the highest energy positron group with the end-point energy at 4.80 Mev decaying with the same half life. Isomeric transition from the shorter to the longer lived state proceeds by means of the internal conversion process, and from this process the energy separation between the two states was estimated to be 89 kev. Definite assignments of spin and parity to the three lowest levels and predictions of some other levels in ^{102}Pd and to two levels in ^{102}Ag were made on the basis of internal conversion coefficient data, selection rules in beta and gamma decays, and theoretical predictions. Information concerning the three lowest levels supports the asymmetric rotor model developed by Davydov and Filippov. (Dissertation Abstr.)

8167 ANGULAR CORRELATION METHODS IN GAMMA-RAY SPECTROSCOPY. Ferguson, A. J. New York, John Wiley and Sons, Inc., 1965. 223p. $8.50.

An exposition is given on the theory and practice of gamma ray correlation studies as applied to problems in nuclear spectroscopy. Studies made with particle accelerators, radioactive sources, and polarization equipment are covered. Finite counters are treated by the concept of the efficiency tensor, and triple correlation analysis is discussed in detail. Tabulations of most of the coefficients required in angular correlation studies are given, including the $\overline{Z}$ coefficients that result from Hubby's correction to the Wigner-Eisenbud resonance theory. (J.F.P.)

8168 EXPERIMENTAL RESULTS ON ELECTRON CAPTURE IN THE L AND M SHELLS: THE M/L CAPTURE RATIO OF ^{109}Cd [Thesis]. Moler, Robert Byron. Little Rock, Ark., Univ. of Arkansas, 1965. 76p.

A measurement of the M/L-capture ratio in ^{109}Cd was carried out using a multiwire proportional counter with internal anticoincidence, the source being introduced directly into the counter as gaseous $Cd(CH_3)_2$. The result of this investigation was $P_M/P_L = 0.232 \pm 0.020$. When compared to theory, this result is in very good agreement. As a secondary result of this investigation, a value of the transition energy Q_{EC} was derived from a measurement of the P_L/P_K ratio. This value, $Q_{EC} = 80^{+1}_{-3}$ kev, is in good agreement with most previously measured precision values of this quantity. (Dissertation Abstr.)

8169 INELASTIC SCATTERING OF HIGH ENERGY ELECTRONS BY NUCLEI WITH CLOSED SHELLS [Thesis]. Grunbaum, L. Munich, Tech. Univ., 1964. 61p. $2.00 Gmelin, AED-DISS. 64-844.

Experimental form factors of inelastic high energy electron scattering by O are compared with theoretical data. Calculated levels with uneven parity are in agreement with experiments. Agreement is rather poor for the electric monopole level and for the 22.7 Mev-giant resonance. The electric octupole levels with spin 0 are very collective. (Gmelin Inst.)

8170 THE INFLUENCE OF RESIDUAL INTERACTION ON THE LOCATION OF GIANT RESONANCES IN NUCLEAR MATTER [Thesis]. Krappe, H. J. Munich, Tech. Univ., 1964. 61p. $2.00 Gmelin, AED-DISS. 64-845.

F-sum, symmetry energy, effective mass, response function for long waves, and location of the dipole giant resonance for nuclear matter are calculated using Hartree-Fock approximation. Dependence on effective interaction is studied. Response function and F-sum depend strongly on nuclear matter density. Agreement with experimental results is satisfactory. (Gmelin Inst.)

8171 STUDIES OF GIANT DIPOLE RESONANCES IN HEAVY DEFORMED EVEN-EVEN NUCLEI BY MEANS OF HIGH ENERGY ELECTRONS [Thesis]. Scheck, F. Freiburg i. B., Univ., 1964. 61p. $2.00 Gmelin, AED-DISS. 64-587.

Cross sections for excitation of giant dipole resonances by electrons are calculated by means of partial wave analysis. For the description of nuclear states the hydrodynamic model is used. Results indicate that inelastic electron scattering is a very sensitive tool for the study of proton charge and current densities in excited states. (Gmelin Inst.)

8172 ^{206}Hg AS A BRANCHING MEMBER OF THE U–Ra DECAY SERIES [Thesis]. Wolf, K. Munich, Tech. Univ., 1964. 49p. $2.00 Gmelin, AED-DISS. 64-580.

Methods for the separation of ^{206}Hg, which is an α-branching product of ^{210}Pb, are described. Half life of ^{206}Hg is 8.2 ± 0.3 min. The branching ratio is $(2.7 \pm 0.6) \times 10^{-8}$. The γ-energy is 310 kev. (Gmelin Inst.)

8173 THE THEORY OF NUCLEAR PHOTO EFFECT IN STRONGLY DEFORMED NUCLEI [Thesis]. Muenchow, L. Dresden, Tech. Univ., 1964. 127p. $2.00 Gmelin, AED-DISS. 64-751.

It is demonstrated that the formalism of approximative second quantization can be used for the description of collective excitation in nuclei. Excitation energies of the dipole state of an idealized nucleus are calculated. The possibilities to include correlations in the ground state are discussed. (Gmelin Inst.)

8174 THE INFLUENCE OF COULOMB INTERACTION ON THE FINE STRUCTURE OF THE α DECAY OF DEFORMED EVEN-EVEN NUCLEI [Thesis]. Huber, M. G. Freiburg i. B., Univ., 1964. 41p. $2.00 Gmelin, AED-DISS. 64-755.

Angular momentum exchange by Coulomb interaction without spherical symmetry of both decay products are calculated. Results are in agreement with the assumption, that α particles are distributed uniformly over the nuclear surface. The observed structure is produced by Coulomb interaction of the deformed nucleus with the α particle. The fine structure depends on the sign of deformation. (Gmelin Inst.)

8175 STUDIES OF THE ^{191m}Ir DECAY [Thesis]. Lange, D. Goettingen, Ger., Univ., 1964. 69p. $2.00 Gmelin, AED-DISS. 64-748.

The γ-spectrum of ^{191m}Ir is studied. K conversion coefficient of γ_2 (129-kev) is 2.32. The ratio of capture cross sections for the reactions ^{184}Os (n,γ) and ^{190}Os (n,γ) was determined. Assuming a cross section for the second reaction of 5.3 barn the value for the first reaction is 1800 barn. The γ-spectrum measured with a fast slow coincidence arrangement has a 43-kev line which can be interpreted as unconverted γ-radiation of the E3 transition. The conversion coefficient of the γ_1-transition is 12,200 ± 4,300. (Gmelin Inst.)

8176 THE INFLUENCE OF A DEFORMATION CHANGE ON (d,p) CAPTURE PROBABILITIES IN THE VICINITY OF THE NEUTRON NUMBERS 88-90 [Thesis]. Hebach, H. Mainz, Univ., 1964. 60p. $2.00 Gmelin, AED-DISS. 64-765.

The decreased overlapping of the nuclear wave function for (d,p) processes is calculated for the case that the initial and the product nucleus have different equilibrium deformation. The wave function is assumed to be the product of collective and internal motion. Reduction factors are given. (Gmelin Inst.)

8177 PROTON AND ^{3}He RADIATIVE CAPTURE REACTIONS LEADING TO STATES OF ^{10}B AND ^{12}C [Thesis]. Blatt, Sherwyn Leslie. Stanford, Calif., Stanford Univ., 1965. 130p.

Two detection systems suitable for studies of gamma rays produced in various radiative capture reactions in light nuclei were constructed. One system, a three-crystal pair spectrometer with good response for gamma rays between 2 and 13 Mev, was applied to investigations of the reactions ^{9}Be(p,γ)^{10}B and ^{11}B(p,γ)^{12}C. The second system, which had good line shape for gamma rays up to 30 Mev, efficient cosmic ray rejection, and anti-pile-up circuitry, was used in studies of the reactions ^{7}Li(^{3}He,γ)^{10}B and ^{9}Be(^{3}He,γ)^{12}C. In the study of the ^{9}Be(p,γ)^{10}B reaction relative intensities of gamma rays observed at 0.99- and 1.08-Mev bombarding energies are in general agreement with the results of other investigators. The 2.4-Mev transition from the 0^+, T = 1

state at 7.56 Mev appears to go to the recently discovered 5.18-Mev state, in agreement with the J = 1, T = 0 assignment for the latter state; observed broadening of the gamma ray indicates $\Gamma \leq 110$ kev for this state. The reaction $^{7}Li(^{3}He,\gamma)^{10}B$ was investigated for bombarding energies from 0.8 to 3.0 Mev. Gamma rays to the ground and first five excited states of ^{10}B were observed. Possible spin and parity assignments are given. Lower limits for the quantity $(2J + 1)\Gamma_\gamma$ are given for the prominent transitions; the values range from 35 to 200 ev. In a search for theoretically predicted 2^+ levels in the 10- to 12-Mev region in ^{12}C, the reaction $^{11}B(p,\gamma)^{12}C$ was studied. Transitions to this energy region from the 2^- (T = 1) state at 16.57 Mev were sought. No gamma rays to the known states at 10.84 and 11.83 Mev were found. Neither of these states appear to have spin 2^+. A transition to the 12.71-Mev state was found and observed to be resonant at the 16.57-Mev state, with a strength consistent with the 1^+ assignment previously suggested, and the T = 1 assignment for the 16.57-Mev state. The radiative capture of ^{3}He by ^{9}Be was studied between 1.0- and 3.0-Mev ^{3}He energies. Transitions to the ground and first two excited states were observed. (Dissertation Abstr.)

8178 METHOD FOR THE PRODUCTION OF ^{33}P BY THE NUCLEAR REACTION $^{33}S(n,p)^{33}P$. Godar, Serge (to Euratom). German Patent 1,201,925. Sept. 30, 1965. Priority date June 19, 1963, Belgium.

The method comprises the steps of generating protons of about 2.7 Mev in a particle accelerator, which are used for the generation of neutrons in the reaction $^{7}Li(p,n)^{7}Be$, and of reacting the neutrons obtained with ^{33}S. (Gmelin Inst.)

Plasma Physics and Thermonuclear Processes

See also Fluid Physics and Thermodynamics

Refer also to abstracts 7005 and 7991.

8179 (ARL–65-202) THE WAVE NATURE OF MOVING STRIATIONS. Lee, D. A.; Garscadden, A.; Bletzinger, P. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Oct. 1965. 17p. CFSTI $1.00 cy.

The results are presented of time and space resolved measurements on the response of the positive column of a low-pressure glow discharge to external perturbations. From these the profile, structure and the backward wave nature of moving striations are clearly indicated. A new method of solution to the equation originally presented by Pekarek is shown to contain all of the experimental results including the dispersion of a pulse disturbance. A stability criterion is derived; especially useful is that the onset of striations in a discharge can be calculated from a quadratic equation. (auth)

8180 (IAE–912) NAGREV ELEKTRONOV V USTANOVKE TN-1. (Heating of Electrons in a TN-1 Apparatus). Blinov, P. I.; Gavrilov, B. I.; Zakatov, L. P.; Cheremnykh, P. A. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 8p. Dep. mn.

It was previously shown that plasma may be heated turbulently by means of a pulsed high-frequency circuit. In order to apply this principle for the heating of the electron component of the plasma, the TN-1 machine was constructed. The quasistatic field H_0 reached its maximum of 8 kiloOersted after 5 msec. At a voltage of $U_K = 120$ kv and a capacity of $C_K = 3 \times 10^{-8}$ f, the single-loop circuit, with a frequency of 3.5 megahertz created a field of $\tilde{H} = 900$ Oersted. A deuterium-fed coaxial injector made of Ti was used to introduce the plasma into the trap; it was possible to change the plasma concentration from $n_e > 2 \times 10^{13}$ cm^{-3} to $n < 10^{11}$ cm^{-3} by changing the voltage. The cold plasma in the trap was decomposed with a time constant $\tau = 300$ μsec. It was noted that when the plasma was heated in the concentration range from 10^{12} to 10^{13} cm^{-3}, radial magnetohydrodynamic waves propagated through it. Magnetic probe data indicated that in the case of pinch waves, i.e., when the alternating magnetic field is added to the quasistatic field, the steepness of the wave front becomes increased two to fourfold with respect to the wave in vacuum, in which case the wave is distorted. It was found that electrons with two different energies were present in the system. After filling the trap by means of the injector, a 20-kev X radiation was found for a period of 25 msec; this is probably due to an accelerating mechanism. (TTT)

8181 (LA–3434) SEMIANNUAL STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING OCTOBER 31, 1965. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Nov. 1965. Contract W-7405-eng-36. 91p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Separate papers and results are presented on the caulked stuffed cusp minimum B machine, plasma focus experiment, Scylla IV power-crowbarred measurements, Scylla IV operation, Scylla IV curved sector experiments, possible single-turn mirror inserts for Scylla experiments, analog solution of multipole stabilizing conductors, the small θ-pinch machine Scyllacita, Scylla I laser experiments, and magnetic mirror machine equipment development and testing. In addition, brief summaries of work are presented on Scylla plans, Fabry-Perot monochromator for scattering experiments, giant-pulse ruby laser for scattering experiments, hydromagnetic plasma gun program, transverse injection, dI/B stable closed systems, computation of electric and magnetic fields, and thermonuclear reactor blankets. (M.O.W.)

8182 (MPI-PAE/P1,11/65) BETRACHTUNGEN ZUR BEWEGUNG EINES TOROIDALEN PLASMAS IN MAGNETFELD. (Reflections on the Motion of Toroidal Plasmas in a Magnetic Field). Lotz, W.; Rau, F.; Wolf, G. H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). July 1965. 11p. Dep. mn.

The plasma of a toroidal theta-pinch in a purely azimuthal magnetic field is not in equilibrium because there is a force acting antiparallel to the field gradient. There are also other forces that tend to deform the plasma. For the case of pure surface currents, the acceleration perpendicular to the plane of the torus is deduced. (auth)

8183 (R–65SD29) MEASUREMENT OF PLASMA DENSITIES BY VACUUM ULTRAVIOLET ABSORPTION SPECTROSCOPY. Gloersen, P.; Collins, S. F. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Nov. 1965. 17p.

Plasma densities are usually measured by determining the electron densities by a variety of techniques. Under certain circumstances, it is desirable also to know the identities of the associated ions as well as their densities and location relative to the electrons and to know what and how many neutral atoms and molecules are present. A straightforward means of accomplishing this at least qualitatively is through vacuum ultraviolet absorption spectroscopy, since most ions, atoms, and molecules have their resonance absorption spectrum lines in this region. Quantitative measurements require the knowledge of oscillator strengths and line shapes for the respective resonance lines. The general considerations in applying this technique are discussed, along with a numerical example using the 1470 Å resonance line of xenon. (auth)

8184 (UCRL–16308) INVESTIGATION OF THE HELIUM HYDRIDE MOLECULAR ION FOR INJECTION INTO THERMONUCLEAR PLASMAS [Thesis]. Wilson, Walter Davis (Lawrence Radiation Lab., Univ. of California, Berkeley). Sept. 27, 1965. Contract W-7405-eng-48. 59p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

An investigation is made of the helium hydride molecular ion HeH^+, as an injection material for thermonuclear plasmas. An experiment is described that is designed to determine the HeH^+ dissociation by subjecting a HeH^+ beam

to electric fields equivalent to v × B fields that would be encountered in an injection system. (auth)

8185 (LA-tr-65-26) PHENOMENA FOLLOWING THE FORMATION OF DENSE PLASMA FOCUS IN THE CUMULATION OF A NON-CYLINDRICAL Z-PINCH. Filippov, N. V.; Filippova, T. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR). Translated by S. Roman (Los Alamos Scientific Lab., Univ. of California, N. Mex.), from report IAE-913. 1965. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $2.60 fs, $0.83 mf.

Investigations of the central region of discharge in deuterium are carried out on a pinch installation using a 180 μf capacitor bank and a chamber with metal walls. The velocities of the plasma sheath are measured to be up to 4×10^7 cm/sec. The numbers of gamma quanta (more than 10^{14}) and their energy (100 to 300 kev) increase with decreasing initial pressure, and at the same time the neutron radiation shows an inverse dependence and a maximum at 1.2 torr. Neutron time-of-flight measurements show that the neutron intensity is practically independent of the observed axial anisotropy of the velocity. At the same time, the neutron intensity is found isotropic with an accuracy better than 5%, which is inconsistent with the conventional target description of the generation of neutrons. A mechanism is proposed to explain the experimental observations. A 2% addition of xenon to the deuterium results in a stabilization of the neutron intensity, at the same time increasing the yields of neutrons and soft x rays. The energy contained by the plasma in the focus of compression is estimated as 100 kjoule.cm^{-3}, or nT = 10^{23} to 10^{24} ev.cm^{-3}. This amount of energy at temperatures of 1 to 3 kev, typical for such discharges, corresponds to a concentration of (1 to 3) × 10^{20} cm^{-3} or a radius of pinch smaller than 0.5 mm. (auth)

8186 (MATT-Trans-14) EXPERIMENTS WITH JOULE HEATING OF A PLASMA IN THE TOROIDAL MACHINE TOKAMAK-3. Artsimovitch, L. A.; Afrosinov, V. V.; Glaskovsky, I. P.; Petrov, M. P.; Strelkov, V. S. Translated from Paper CN-21/245 Presented at the IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Culham, England, Sept. 6–10, 1965. 29p. Dep. mn; CFSTI $2.00 cy, $0.50 mn; JCL $2.60 fs, $1.07 mf.

Measurements of properties of Joule-heated toroidal plasma having major radius of 100 cm, carrying currents of 20 to 50 ka for durations of 20 to 22 msec, are reported. Plasma motion, stability, electric characteristics, ionization behavior, heating, and particle fluxes are studied. (T.F.H.)

8187 (UCRL-Trans-1275(L)) ANOMALOUS ESCAPE OF IONS INTO THE "LOSS CONE." Galeev, A. A. Translated for Univ. of California Lawrence Radiation Lab., Livermore, from paper No. CN-21/214 Presented at the IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Culham, England, Sept. 6–10, 1965. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $2.60 fs, $0.83 mf.

An investigation was made to determine the oscillation spectrum in an unstable plasma and the associated diffusion of ions into the loss cone which leads to the escape of ions from the trap through the magnetic mirrors. The leading results of the linear theory of instability are briefly reviewed and then generalized to the case of a partly filled loss cone. Discussions are then presented on nonlinear instability theory, turbulent diffusion of ions into the loss cone, and a model of stable collisionless plasma. (M.O.W.)

8188 EXCITATION OF THE HELICAL WAVE IN THE POSITIVE COLUMN. Nishida, Yasushi; Hatta, Yoshisuke; Sato, Masumi (Tohoku Univ., Sendai). Appl. Phys. Lett., 7: 251-2(Nov. 1, 1965).

A brief explanation is given of experiments on helical wave excitation in a weakly ionized cylindrical plasma with a longitudinal magnetic field below the critical value at which the helical instability begins. The experimental apparatus is shown. (L.B.S.)

8189 INVESTIGATIONS ON THE X-RAY EMISSION FROM AN ELECTRODELESS LOW-PRESSURE PULSE DISCHARGE. Waehnert, Claus (Institut fuer Magnetohydrodynamik, Deutsche Akademie der Wissenschaften, Jena, Ger.). Beitr. Plasmaphys., 5: 259-72(1965). (In German).

A plasma betatron was proposed by Steenbeck in 1943; its basic principle is like apparatus of the Perhapsatron type later used for nuclear fusion studies. A study was made to determine whether such an installation is suitable for the production of strong runaway electron currents. Under special discharge conditions two strong electron currents with energies of the order of magnitude of 10 kev could be detected; certain disturbing influences, however, prevented the generation of significant currents of relativistic electrons. (tr-auth)

8190 INVESTIGATION ON THE DIAGNOSTICS OF A HOMOGENEOUS ISOTROPIC PLASMA BY BEAM PHASE SHIFT IN THE REFLECTION OF ELECTROMAGNETIC WAVES. Schilling, Heinz (Technische Hochschule Otto von Guericke, Magdeburg, Ger.). Beitr. Plasmaphys., 5: 273-90(1965). (In German).

In the reflection of polarized electromagnetic waves, a large shift of the reflected wave with respect to the incident wave occurs in a narrow range around the limiting angle of total reflection or in incident solid angles for a narrow-frequency band. A sharply defined beam incident under the limiting angle whose transmission frequencies are spread over a given range produces after its reflection on the plasma an expanded spot of light instead of a point. The limiting angle is dependent on the ratio between plasma and transmission frequency, and the maximum shift value is dependent essentially on the collision frequency. From the measurement of the limiting angle or the limiting frequency and the maximum beam shift, the concentration and collision number can be found, and, with the additional knowledge of the scattering cross section, the plasma temperature can be determined. (tr-auth)

8191 THE MOVEMENT OF THE ARC PROJECTION ON PLASMA BEAM HOLLOW ANODES. Moritz, J.; Neumann, W.; Rademacher, K. (Physikalisch-Technisches Institut, Deutsche Akademie der Wissenschaften, Berlin). Beitr. Plasmaphys., 5: 291-306(1965). (In German).

An anode projection motion within the hollow anode of a plasma beam generator operating with argon could be detected by measurement of the current distribution on individual anode plates, by determination of the operating oscillations, and with film exposures. The anode projection motion is at a minimum at a low gas flow (about 500 l/hr of Ar) and assumes at values for the gas flow over 1000 l/hr, more accurately over a minimum cold input velocity in the anode channel of 40 m/sec, values of 1 kc and over. The mechanism of motion of the focal spot is explained. The results are of significance for the construction of anodes of plasma beam generators which must be fabricated so that in the case of the existence of focal spots these would exhibit a rate of motion as large as possible. (tr-auth)

8192 THE POSITIVE COLUMN OF ARGON LOW-PRESSURE DISCHARGE IN THE TRANSITION REGION. [PART] III. Wojaczek, Karl (Physikalisch-Technisches Institut, Deutsche Akademie der Wissenschaften, Berlin). Beitr. Plasmaphys., 5: 307-29(1965). (In German).

Even with discharge current intensities of the order of magnitude of several amps, only energies below the lowest excitation energy U_α with a Maxwell velocity distribution can be calculated for electrons in the positive column of the argon low-pressure discharge. At energies over U_α, so large a deficit in fast electrons exists that directionizing collisions of the electrons with unexcited atoms can play no role, and the charge-carrier production must follow step-wise over long-lived excited atoms. The elimination of excited atoms occurs by stage elimination and by radiation processes; collisions of the second type with slow electrons play no role. The charge carriers recombine on the tube wall. A theory corresponding to this representation of the positive column is developed. The adapta-

tion of the electron temperatures and potential gradients calculated by this theory to the values measured in argon in the Pupp transition range makes it possible to draw, under certain conditions, conclusions on the intensity of the electron interaction, the cross section for the stepwise excitation and ionization, and the effective radiation lifetime of the excited atoms. The formulations developed were verified in the discussion of determining magnitudes for layer formation, which characterize the dependence of the ionization rate and the energy loss rate on the electron temperature and the electron concentration. (tr-auth)

8193 PROBES IN ATMOSPHERIC PRESSURE ARGON PLASMA. Nation, J. A.; Simpson, D. (Central Electricity Research Labs., Leatherhead, Eng.). Brit. J. Appl. Phys., 16: 1699-1704(Nov. 1965).

Theoretical and experimental results are presented for the current flow between two water-cooled brass electrodes immersed in a moving, atmospheric pressure, argon plasma. It is shown that for low applied potentials the current flow is limited by the positive ion diffusion rate (or mobility) through a potential sheath existing close to either electrode. The experimental results give good agreement with the general characteristics predicted on the basis of the theoretical calculations. The numerical values of the experimental results in the temperature range 3500–4500°K are in order-of-magnitude agreement with predicted results where the ion diffusion rate used has been taken from kinetic theory calculations. Some discussion is given of the limitations of the theoretical treatment. (auth)

8194 A MEASUREMENT OF THE EFFECTIVE THICKNESS OF THE PLASMA SHEATH AT A COLD ELECTRODE. Nation, J. A.; Simpson, D. (Central Electricity Research Labs., Leatherhead, Eng.). Brit. J. Appl. Phys., 16: 1705-9(Nov. 1965).

The concept of potential sheaths, existing close to cold probes, is commonly used in examining current flow from a plasma to external electrodes. A technique is described by which the effective thickness of this sheath can be determined experimentally, by measuring the capacitance of the electrode-plasma system. It was found that over the temperature range 3500–5000°K the effective sheath thickness is comparable to the Debye length of the plasma. The experimental results presented were obtained in weakly ionized argon at atmospheric pressure. (auth)

8195 CONFINEMENT OF A NOT-VERY-DENSE PLASMA BY STATIC MAGNETIC AND HIGH FREQUENCY FIELDS. Consoli, Terenzio; Mourier, Georges; Roux, Rolland; Vial, Pierre (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Compt. Rend., 261: 3314-17(Oct. 27, 1965). (In French).

A series of experimental results showing the efficiency of h-f fields of the TE_{110} spherical mode associated with a static magnetic field of parabolic shape for the confinement of not very dense plasmas are reported. (tr-auth)

8196 FABRY-PEROT HYPERFREQUENCY INTERFEROMETER FOR THE MEASUREMENT OF VERY WEAK DENSITIES. Bize, Daniel (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Compt. Rend., 261: 3318-20(Oct. 27, 1965). (In French).

A Fabry-Perot interferometer with focusing optics developed on the 2.2-mm wavelength is described. This interferometer makes it possible to measure the electron density of a plasma in evolution. (tr-auth)

8197 COMPARISON OF THE DATA GIVEN BY TWO LANGMUIR PROBES PLACED IN AN IONIZED CESIUM DEVICE. Felden, Marceau; Haug, Robert; Patou, Claude (Laboratoire de Physique Theorique et Nucleaire, Nancy). Compt. Rend., 261: 3321-4(Oct. 27, 1965). (In French).

The data furnished by two Langmuir probes placed in a Cs plasma device were studied. The plasma was obtained by contact ionization by a hot surface. The probes were mobile and perpendicular to each other. The Cs pressure varied between 10^{-6} and 10^{-2} torr. (tr-auth)

8198 NON-ADDITIVE ENTROPY OF A THERMALLY INHOMOGENEOUS SYSTEM. Imshennik, V. S. Dokl. Akad. Nauk SSR, 162: 310-13(May 11, 1965). (In Russian).

An ideal electron-ion plasma is considered, where the potential energy of the charged particle interaction is small as compared with the kinetic energy of the thermal flow and the following inequality is a condition for the ideality of the plasma: $D \gg d$, $D = (k\theta/4\pi e^2 nZ)^{0.33}$. Here D is the Debye radius expressed by the electron temperature θ and the ion density n; d is the average distance between plasma particles; k is the Boltzman constant; e is the electron charge, and Ze is the ion charge. The condition of electrical neutrality is: $n_e = Zn$. The equations of state of a two-temperature plasma with ion temperature $T \neq \theta$ is formulated as follows: $p_i = NkT$, $p_e = ZNk\theta$, $E_i = 1.5\ p_i/\rho$, $E_e = 1.5\ p_e/\rho$ and $\rho = NM$, where M is the ion mass. The thermodynamic relations for both components of the plasma are described as follows: 1) $dE_i = TdS_i - p_i dV$, and 2) $dE_e = \theta dS_e - P_e dV$. Here S_i and S_e are the ion and electron entropies respectively. The amount of heat dQ in this case has an integrating multiplier, and can be expressed in explicit form as follows: $dQ = dE + pdV = 1.5\ Rd\ (T + Z\theta) + R(T + Z\theta)\ d\ln V$. A function of state S* which is called the non-additive "entropy" of the plasma is derived: $S^* = R(Z + 1)\ln [T + Z\theta]^{1.5}V + S_0^*$. Only at complete equilibrium with $T = \theta = T_0$ does S^* coincide with the entropy of the plasma $S = S_i + S_e$. Here S* is considered as the entropy of a plasma model, where the electron and ion gases are separated by an adiabatic diaphragm. The temperature of the system is a term τ which is taken to be the average internal energy per single elementary particle. (TTT)

8199 STABILIZATION OF CERTAIN INSTABILITIES WHEN PLASMA IS MOVING ACROSS A MAGNETIC FIELD. Lariontsev, E. G. (Moscow State Univ.). Dokl. Akad. Nauk SSR, 162: 536-8(May 21, 1965). (In Russian).

On considering a chute instability in a moving plasma, a perturbation perpendicular to the unperturbed magnetic field within the plasma is introduced. This perturbation does not distort the magnetic field within the plasma. From the dispersion relation it follows that the inhomogeneity in plasma flow velocity has a stabilizing effect on the chute instability, especially with plasma flow transverse to the magnetic field. An analogous stabilization of a constriction instability is found in the case of a cylindrical stream. The current-carrying cylindrical jet is more stable with respect to constriction than is the corresponding cylinder which is at rest. Analogous results are obtained on investigating the stability of a hydrodynamic current under the action of surface tension forces. A liquid cylinder at rest is unstable with respect to constriction under the effect of surface tension forces, but a jet stream can stabilize itself because of the variation in the velocity profile. (TTT)

8200 EXPERIMENTAL INVESTIGATION OF THE BEHAVIOR OF COLLISION WAVES FROM AN INDUCTIVE-HYDRODYNAMIC COLLISION TUBE IN AN AREA OF TWO-DIMENSIONAL FREEDOM. Rothhardt, L. (Institut fuer Magnetohydrodynamik, Deutsche Akademie der Wissenschaften, Jena, Ger.). Exp. Tech. Phys., 13: 283-8(1965). (In German).

Experiments are reported in which a luminescent plasma with a steep front, and flowing with a velocity from 8 to 20 Mach in hydrogen at 5×10^{-2} to 0.5 torr, and the following collision wave were expelled from a shock tube with rectangular cross section in a flat dose. For detection of the fast processes, a drum camera was installed which recorded light phenomena from several aperture series placed over each other in the direction of the collision wave perpendicular from a shield placed in front of the chamber. The evaluation of this type of picture showed that the sharp front in a wedge-shaped area was propagated generally in the forward direction, whereas a weaker front moving at approximately the velocity of sound is introduced at the boundaries of the relatively plane front and is exhausted at the side. The velocity declines within the chamber to the speed of sound; the light signal connected with the front then disappears. The photographs were taken at various

distances from the shock tube end with slits lying across the propagation direction. (tr-auth)

8201 TRANSIENT MODIFICATION OF PLASMA INHOMOGENEITY BY ION OSCILLATIONS. Emeleus, K. G.; Jones, J. M. (Queen's Univ., Belfast). Int. J. Electron., 19: 111-13(Aug. 1965).

Attention is called to some effects of plasma ion waves in inhomogeneous plasmas, in particular, the way in which they may produce local transient uniformity, and in this, and possibly other ways, control the location and growth of plasma electron oscillation. (auth)

8202 INDUCED VOLTAGE PRODUCED IN AN INTERACTION BETWEEN A MOVING CONDUCTING RING AND A MAGNETIC FIELD. McCutcheon, M. J.; Poularikas, A. D.; Akhurst, D. O. (Univ. of Arkansas, Fayetteville). J. Appl. Phys., 36: 3592(Dec. 1965).

The induced voltage produced when a conducting ring moves into the magnetic field associated with a current-carrying ring was calculated and was verified experimentally. The voltage is induced in a search coil placed immediately adjacent to the current-carrying ring. (D.C.W.)

8203 ON THE REFRACTORY DUST METHOD. Anderson, Wallace L.; Rosen, Gerald (Southwest Research Inst., San Antonio, Tex.). J. Appl. Phys., 36: 3760-5(Dec. 1965).

A detailed theory is developed for the effective absorption of free electrons in a plasma by dust (micron-size) particles of a chemically inert refractory material. The analysis reveals a sharply defined regime of practical applicability for this refractory dust method. (auth)

8204 THREE-FLUID ANALYSIS OF A HYDROMAGNETIC WAVEGUIDE. Willett, Joseph E.; Sodek, Benard A. Jr. (General Dynamics/Fort Worth, Fort Worth, Tex.). J. Appl. Phys., 36: 3863-75(Dec. 1965).

A three-fluid method is developed for analyzing the modes of propagation in a waveguide filled with a partially ionized magnetoplasma. The method of approach involves the derivation of an effective Ohm's law from the three-fluid equations of motion. Dispersion relations are obtained for hydromagnetic and acoustic waves. The effects of neutral particles are shown explicitly for two limiting cases; namely, weak coupling and strong coupling between the neutral-particle gas and the electron-ion gas. The effects of Hall current, pressure, and resistivity are shown in the limit of negligible coupling. (auth)

8205 ELECTROMAGNETIC SCATTERING BY FINITE DENSE PLASMAS. Wyatt, Philip J. (Defense Research Corp., Santa Barbara, Calif.). J. Appl. Phys., 36: 3875-81(Dec. 1965).

The often-used hypothesis that a large overdense plasma medium may be treated as a perfect reflector is critically examined using a large homogeneous plasma sphere for particular emphasis as a simple scattering volume. This hypothesis is found to be in substantial error for densities between about four and $\kappa a/2$ times the critical density where κ is the vacuum propagation constant of the incident field and a is the radius of the scatterer. The anomalous scattering in this restricted density range arises because of interference effects between the backscattered wave and tightly bound surface waves. These surface waves are of considerable importance for even very large ($\kappa a \sim 700$) scatterers. The effects of absorption and inhomogeneity are also discussed. In general, it appears that deductions based on radar and other backscatter measurements are of questionable validity for a rather broad range of ionized scattering media. (auth)

8206 ENHANCEMENTS IN THE ELECTRON TEMPERATURE IN NONEQUILIBRIUM-Ar PLASMAS SEEDED WITH Na. Hiramoto, Tatsumi; Yano, Syukuro; Matsunaga, Sakuro; Shirakata, Hirofumi (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Jap., 20: 1910-20 (Oct. 1965).

Spectroscopic measurements of the electron temperatures T_e, were made for the atmospheric argon plasmas seeded with sodium vapors at gas temperatures above 2000°C. The relation between T_e and current density j was also obtained. The values of j calculated from the measured T_e and seeding ratios agree well with the experimental values. These results indicate that an electron energy equation containing radiation loss terms is applicable to the estimation of the nonequilibrium ionization in the working plasmas for the magnetoplasmadynamic power generating systems. (auth)

8207 HIGH-FREQUENCY CONDUCTIVITY OF A PLASMA IN A MAGNETIC FIELD. Itikawa, Yukikazu (Tokyo Univ.). J. Phys. Soc. Jap., 20: 1921-5(Oct. 1965).

The response of a plasma in a magnetic field to an electric field oscillating with frequencies higher than the collision frequency is investigated in the unified theory without any cut-off procedure. A general form of the electric current due to the applied field is obtained and the conductivity is calculated. With use of the connection formula the exact Coulomb logarithms are obtained. The Coulomb logarithm in the components of the conductivity perpendicular to the magnetic field differs from the one in the parallel component. Some limiting cases are treated in detail. (auth)

8208 GRAVITATIONAL INSTABILITY IN A PLASMA IN A MAGNETIC FIELD. II. PARTICLE PICTURE FOR COLLISIONAL DAMPING IN A WEAKLY IONIZED PLASMA. Kawakami, Ichiro; Sato, Masatomo (Nihon Univ., Tokyo). J. Phys. Soc. Jap., 20: 1925-35(Oct. 1965).

The instability of a plane boundary of plasma supported under gravity by a magnetic field is investigated in the first order orbit theory taking into account the collisions between charged and neutral particles, where the collision frequency is assumed to be small as compared with the Larmor frequency. It is demonstrated that the instability growth rate may be suppressed by collisions of ions with neutral particles, and the physical mechanism of the stabilization is the "discharge" of surface charges as a result of the collisional drift motion of ions which takes place across the magnetic field in the direction of the produced electric field. The results are applied to the slow theta-pinch experiments in order to understand the observation of no Rayleigh-Taylor instabilities in the contraction stage of the slow theta-pinch. (auth)

8209 SCATTERING RESONANCES OF A CYLINDRICAL PLASMA. Leavens, William M. (National Bureau of Standards, Boulder, Colo). J. Res. Nat. Bur. Stand., D, 69D, 1321-33(Oct. 1965).

The Vlasov equation was solved for the plasma resonance spectra of a realistic model by the conductivity kernel method. The results give a clearer picture of the nature of plasma resonance than heretofore available. The calculation includes Landau damping and does not impose unphysical boundary conditions. The problem of chief interest is the scattering of electromagnetic radiation near the electron plasma frequency from a cylindrical plasma when the wave vector and polarization are perpendicular to the cylinder axis. The cylindrical problem reduces to the problem of the steady, driven, oscillations of a thin one-dimensional slab of collisionless, Maxwellian plasma, with a wall at $x = 0$ which emits electrons and absorbs all electrons that return to $x = 0$, and an insulated wall at $x = x_w$ which also absorbs electrons. A model is used in which the unperturbed electric field, everywhere in the positive x-direction, is uniform in the plasma, $0 \leq x \leq s$, and joins smoothly to a harmonic oscillator field in the sheath $s \leq x \leq x_w$. The conductivity kernels for a large number of frequencies were calculated, and inverted, on large electronic computers. The results show that much of the Landau damping which determines the line shapes is concentrated near the sheath, and the resonance frequencies are determined by the properties of the sheath and the neighboring regions of the plasma. (auth)

8210 OBSERVATION OF A NON-CONVECTIVE INSTABILITY IN A BEAM-PLASMA SYSTEM. Tamano, Teruo (Tokyo Univ.). Jap. J. Appl. Phys., 4: 987-91 (Dec. 1965).

The interaction between a primary unmodulated beam of electrons and a plasma in a magnetic field was investigated experimentally. The non-convective instability, corresponding to the coupling of the slow space-charge wave and the backward plasma wave, was observed and the start-oscillation condition was observed. The measured energy spectra show the presence of accelerated electrons of the beam besides decelerated ones. (auth)

8211 PLASMA LINEAR ACCELERATOR. [PART] I. Ishizuka, Hiroshi; Susuki, Yasuo (Tokyo Univ.). Jap. J. Appl. Phys., 4: 994-1001(Dec. 1965).

The acceleration of a plasma bunch in an evacuated waveguide by the pressure of a powerful microwave is investigated theoretically. It is indicated that the pressure exerted on the plasma is increased by equipping the accelerating waveguide with a microwave filter. A large portion of the electromagnetic energy fed into the waveguide can be transferred to the plasma. The problem of focusing is treated for simple configurations of plasma in rectangular waveguides by calculating the field pattern and applying the method of effective potential. Under proper conditions the accelerating wave acts to focus the plasma bunch. The dissipation of electromagnetic energy in this method of acceleration is discussed. (auth)

8212 PLASMA LINEAR ACCELERATOR. [PART] II. Ishizuka, Hiroshi; Suzuki, Yasuo; Miyamoto, Goro (Tokyo Univ.). Jap. J. Appl. Phys., 4: 1002-9(Dec. 1965).

The acceleration of a plasma bunch by the radiation pressure was investigated experimentally with pulsed operation of a 2Mw magnetron. A plasma gun was contrived and used as an injector that produced a small bunch of plasma containing 10^{12-14} ion pairs. Carbon ions and fluoric ones, which were main components of the plasma, were accelerated up to 70 kev at the highest and to 4.6 kev on the average. Theoretical predictions were verified as far as the acceleration of a plasma bunch by the single reflection of the wave was concerned. (auth)

8213 COLLISIONAL DAMPING OF THE WHISTLER MODE IN A DENSE, WARM MAGNETO-PLASMA. Watanabe, Hiroshige (Tohoku Univ., Tokyo); Nagao, Shigeo. Kakuyugo Kenkyu, 15: 1-23(July 1965). (In Japanese).

In the cold-collisionless plasma theory, it is shown that the whistler mode propagates through an overdense magnetoplasma (i.e., a plasma whose plasma frequency is greater than the frequency of the wave) at a frequency that is below the electron cyclotron frequency of the plasma. In the actual laboratory plasmas, the effects of the collisions may play an important role in the propagation of the waves. Those effects are examined in the case of a warm plasma, such as the after-glow plasma. As the temperature is very low in this case, the Coulomb interaction is considered to play a dominant part rather than electron-neutral collisions. The dispersion equation and the spatial damping constants of the whistler mode were obtained by applying Comisar's method (treating the collisional terms which appear in the Boltzmann-Fokker-Planck equation for longitudinal plasma oscillation) to the corresponding problem for the transverse waves in the presence of a uniform magnetic field. The results of calculations are shown to be in good agreement with experiment. (auth)

8214 ON ADIABATIC INVARIANCE OF A CHARGED PARTICLE IN CUSPED FIELD. Shinano, Kunizo (Osaka Univ.). Kakuyugo Kenkyu, 15: 35-47(July 1965). (In Japanese).

The behavior of a charged particle which moves from a point of weak field toward a strong field region in cusped field is investigated. The equation of motion of a charged particle in cusped field is non-linear and second order with respect to r or z in cylindrical coordinates. By certain transformations which eliminate non-linear terms, it can be reduced to the same kind of equation as that representing the motion of a charged particle in a homogeneous magnetic field which varies in time. If the change in the magnetic field over the distance which a charged particle displaces during one gyration is small, the approximate solution can be obtained by means of WKB method. Such a solution reveals the adiabatic orbit of a charged particle, and also its adiabatic invariant can be obtained. The region in which a charged particle behaves as an adiabatic one is roughly estimated. (auth)

8215 EXPERIMENTS ON COLLISIONLESS SHOCK WAVES. Sakagami, Yukio; Yamanaka, Chiyoe (Osaka Univ.). Kakuyugo Kenkyu, 15: 191-202(Sept. 1965). (In Japanese).

Magnetohydrodynamic shock waves were formed using a magnetically driven plasma embedded in a magnetic field. The maximum speed of the front was 5.6 cm/μs. The preheating of the gas was found to be a very important factor to produce this kind of shock wave. The observed data and calculation show that the plasma behind the front is in almost collisionless state. It is not to be concluded that the observed shock is mainly caused by the collisionless mechanism. (auth)

8216 LASER INTERFEROMETRY OF HIGH DENSITY SHOCKED PLASMA. Nakai, Sadao; Yamanaka, Chiyoe (Osaka univ.). Kakuyugo Kenkyu, 15: 203-16(Sept. 1965). (In Japanese).

The density of shocked plasmas was measured using Mach-Zehnder interferometer with He–Ne gas laser. The device is useful for investigating fast transient phenomena in high electron density such as plasma shock waves. The precise experiments are in progress. (auth)

8217 MICROWAVE INSTALLATION FOR INVESTIGATING THE ELECTROMAGNETIC WAVE AND IONIZED GAS INTERACTION. Belov, V.; Karavaev, E.; Skotar, S. Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser., No. 5, 15-20(1965). (In Russian).

An apparatus for microwave probing of ionized gas is described. The apparatus is a generator of uhf oscillations (λ = 3 cm) with a special waveguide containing a measuring probe and a device for compensating initial reflections in the form of a special bridge. The apparatus allows signals reflected from and transmitted through the ionized gas to be measured. A simplified block scheme of the apparatus and a picture of its external appearance are shown, and recommendations on its practical use are given. Some data from studies using the apparatus are presented. The results agree well with those obtained by the circuit method. (tr-auth)

8218 REFLECTION OF CHARGED PARTICLES BY PLASMA SHOCKS. Hudson, P. D. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc., 131: 23-49(1965).

The reflection and transmission were investigated of charged particles incident on a plane moving plasma shock whose thickness is small compared to the Larmor radius of the particles. When the intersection with the shock moves along the field lines with velocity >c the particles are transmitted and their magnetic moment is conserved. For all other cases, conditions for reflection and transmission are found and numerical results are obtained by computing particle paths. For small differences in field strength the adiabatic invariant holds approximately, but for larger differences the particles are scattered widely both on reflection and on transmission. These results are applied to possible Fermi mechanisms for accelerating cosmic particles. (auth)

8219 THE STATUS OF WORLD FUSION. Furth, Harold P. (Lawrence Radiation Lab., Livermore, Calif.). Nucleonics, 23: No. 12, 64-9(Dec. 1965).

Progress in technology, theory, experimental advances and basic research toward controlled fusion is reported. The study and avoidance of plasma instability is the prime objective of most present-day controlled-fusion research. (L.B.S.)

8220 PHOTON MOMENTUM DISTRIBUTION IN A FULLY IONIZED GAS. Grandy, W. T. Jr. (Univ. of Wyoming, Laramie). Nuovo Cimento (10), 40A: 265-7 (Nov. 1, 1965).

An attempt is made to clarify the nature of the momen-

tum distribution function for photons in a fully ionized gas, within the framework of the mastergraph formulation of quantum statistics. The contributions that involve the interaction of a single charged particle with a photon and the effects of the Coulomb interactions between charged particles in the system are considered. A new momentum distribution and energy-momentum relation are obtained. (L.B.S.)

8221 ON THE MAGNETIC MOMENT OF A CHARGED PARTICLE IN A CHANGING MAGNETIC FIELD. **Parker, L. (Harvard Univ., Cambridge, Mass). Nuovo Cimento (10), 40B: 99-108(Nov. 11, 1965).**

The equation governing the transverse motion of a charged particle in a spatially uniform but time-varying magnetic field is considered. A series is derived which gives the relative change in the magnetic moment of the particle caused by a slow but finite rate of variation of the magnetic-field strength. Under ordinary physical conditions, the series is convergent. The first few terms of the series reduce to an approximation derived by Hertweck and Schlüter, and Chandrasekhar. Therefore, that approximation forms the leading part of a convergent series, but not of an asymptotic series. This accounts for the fact that the approximation of Hertweck and Schlüter gives the correct order of magnitude in certain cases but does not give the correct asymptotic behavior in the limit of slow variation of the field. By using more terms of the series in forming an approximation, the accuracy can be improved. (auth)

8222 WALL AND COLLISION EFFECTS IN PLASMA CAPACITORS. **Cercignani, C.; Pagani, C. D. (Univ., Milan). Nuovo Cimento (10), 40B: 140-67(Nov. 11, 1965).**

The problem of finding the electric field within a plasma-filled plate condenser, upon which an alternating emf is imposed, is considered. The adopted model implies the solution of the Boltzmann-Vlasov system of equations with a single relaxation time collision term, matched by suitable boundary conditions at the walls of the condenser. The plasma is assumed to be completely ionized and the frequency large enough to consider negligible the ion motions. In order to solve the Boltzmann-Vlasov system the method of separating the variables is used. Firstly a general mathematical theory of such solutions is developed, and then applications to the plasma capacitor are considered. Both diffusing and reflecting walls are considered. In the limiting cases of large and small separation of the plates the effective permittivity is evaluated. (auth)

8223 COUPLED OPTICAL AND ACOUSTIC WAVES IN A COMPRESSIBLE PLASMA WITH BOUNDARIES. **Samaddar, S. N. (Raytheon Co., Sudbury, Mass.). Nuovo Cimento (10), 40B: 224-35(Nov. 11, 1965).**

Propagation of coupled optical (electromagnetic) and acoustic waves in a bounded compressible isotropic plasma is studied. The effect of an admittance boundary condition for the flow of fluid elements of a compressible plasma on the behavior of the waves is also discussed. A simple example is worked out to investigate the wave phenomena. It is shown in some special cases that an apparently new type of wave can be excited for nonvanishing hydrodynamic admittance to the velocity of an electron plasma at a metal boundary. In a limiting condition the admittance is calculated, and it is found to depend on the geometrical configuration, the frequency of the external source, plasma frequency, and the adiabatic sound velocity in the electron fluid. In the high-frequency limit this admittance is inversely proportional to the frequency. It is felt that a similar approach can be applied to other radiation and propagation problems involving compressible plasmas in contact with boundaries which may not necessarily be conductors or vacuum. (auth)

8224 EFFECT OF ELECTRON COLLISIONS ON THE SCATTERING AND CONVERSION CROSS-SECTION BY PLASMA INHOMOGENEITY. **Singh, R. N. (Banaras Hindu Univ., Varanasi, India). Nuovo Cimento (10), 40B: 322-6(Nov. 11, 1965).**

Cross sections for the scattering of electromagnetic (EM) and plasma modes by a plasma inhomogeneity and for the conversion from EM to plasma and plasma to EM mode due to scattering by the inhomogeneity in the presence of electron-neutral collisions are obtained by a mode separation technique. The variation of the cross sections with frequency and atomic number is discussed. Application to processes occurring in the solar atmosphere is mentioned briefly. (M.J.T.)

8225 ELECTROMAGNETIC WAVE PROPAGATION AND RELATIVISTIC DAMPING EFFECTS IN A UNIFORMLY MAGNETIZED ELECTRON-POSITRON GAS. **Steinert, L. A. (Univ. of Lund. National Bureau of Standards, Boulder, Colo.). Nuovo Cimento (10), 40B: 345-74(Dec. 11, 1965).**

A relativistic quantum-statistical description is given of electromagnetic wave propagation in a uniformly magnetized electron-positron gas, with specific attention devoted to long-wavelength propagation as determined by the collective approximation. Collisionless absorption effects derived from relativity theory are compared with those obtained from the corresponding nonrelativistic treatment, showing that the two theories predict substantially different effects even for nonrelativistic temperatures. Contrasts appear in the predicted characteristics of the cyclotron resonance absorption effect, including the fact that Landau damping is completely nonexistent in the relativistic gas for waves propagating at phase velocities exceeding the velocity of light. (auth)

8226 MODULATION OF PLASMA PERMITTIVITY BY ION WAVES. **Iannuzzi, M.; Magistrelli, F. (EURATOM-CNEN, Frascati, Italy). Nuovo Cimento (10), 40B: 424-31 (Dec. 11, 1965).**

The results of an experimental study of alkali plasmas contained in a microwave resonator are described. The plasma, produced by thermal ionization in an incandescent cavity operating also as a microwave resonator, is steady and uniform. It is observed that the resonant frequency of the cavity is modulated by ion waves sustained by collective amplification. The experimental results are discussed. (auth)

8227 WAVES IN CYLINDRICAL BEAM-PLASMA SYSTEMS IMMERSED IN A LONGITUDINAL MAGNETIC FIELD. **Groendijk, H.; Vlaardingerbroek, M. T.; Weimer, K. R. U. Philips Res. Rep., 20: 485-504(Oct. 1965).**

The complete dispersion equation for a cylindrical beam-plasma system immersed in a finite longitudinal magnetic field is derived. Since this equation is hard to solve, approximate boundary conditions are introduced. This makes the problem similar to that of the propagation of plane waves at an angle with the beam in an unbounded beam-plasma system. Although the theory can be applied to much more general cases, the interaction of an electron beam with a cold plasma is studied. The motion of the ions was neglected. The results are discussed in detail and compared with the results of other approximations to the problem. (auth)

8228 INTERACTION OF ELECTRON BEAMS WITH INHOMOGENEOUS PLASMAS. **Chen, Francis F. (Princeton Univ., N. J.). Phys. Fluids, 8: 2115-17(Nov. 1965). (MATT-364).**

The possibility is investigated that the low-frequency oscillations superimposed on the radio-frequency oscillations in electron beam interactions with plasma are drift waves excited by the beam. It was found that the transverse motion of the ions makes such an interaction impossible. Curves are given showing the dispersion relation for drift waves in a low-density inhomogeneous plasma in a uniform magnetic field. Also it is shown that no excitation can be expected for arbitrarily large values of the ratio of the beam electron density to the plasma electron density. (J.F.P.)

8229 FLUTE INSTABILITIES AT ION GYROFREQUENCY. **Shima, Yaakov; Fowler, T. K. (Oak Ridge National Lab., Tenn.). Phys. Fluids, 8: 2245-9(Dec. 1965). (ORNL-P-1417).**

Flute modes at the ion gyrofrequency, propagating perpendicular to the magnetic field, are considered. A dispersion relation for inhomogeneous plasmas is obtained from which density thresholds for instabilities are derived. Several plasma distributions are considered. For a loss cone in velocity space, as in mirror machines, the density threshold is given by $(\omega_{pi}/\omega_i) \approx (R/r_{li})^{\frac{1}{2}}$. In the case of a plasma shell with a radial density proportional to r^2 at $r = 0$, $(\omega_{pi}/\omega_i) \approx (R/r_{li})^{\frac{1}{2}}$. Here, ω_{pi} is the ion plasma frequency, ω_i is the ion gyrofrequency, R is the plasma radius, and r_{li} is the ion gyroradius. (auth)

8230 LANDAU SOLUTION OF THE PLASMA OSCILLATION PROBLEM. Taylor, E. C. (Aerospace Corp., Los Angeles). Phys. Fluids, 8: 2250-4(Dec. 1965).

The controversial aspects of Landau's treatment of the initial value problem are discussed. It is demonstrated that any kind of decaying solution other than that of Landau can be obtained for some initial velocity distribution function. Nevertheless, it is shown that several phenomenologically motivated distributions—Maxwellian functions, Lorentzian functions, and smoothly cutoff functions—yield solutions which are dominated by the plasma wave for long periods of time, although the plasma wave may not be present in the asymptotic limit. The distribution functions that are chosen lead to specific examples of each conceivable type of singularity structure for the integrand in the representation of the solution. It is suggested, therefore, that Landau's conclusion that all long-wavelength disturbances in a plasma produce a damped plasma wave which dominates the ensuing behavior is physically correct. (auth)

8231 COLLISIONLESS DAMPING OF NONLINEAR PLASMA OSCILLATIONS. O'Neil, Thomas (Univ. of California, San Diego, La Jolla). Phys. Fluids, 8: 2255-62(Dec. 1965).

It is well known that the linear theory of collisionless damping breaks down after a time $\tau \equiv (m/eEk)^{\frac{1}{2}}$, where k is the wavenumber and E is the amplitude of the electric field. Jacobi elliptic functions are now used to provide an exact solution of the Vlasov equation for the resonant electrons, and the damping coefficient is generalized to be valid for times greater than $t = \tau$. This generalized damping coefficient reduces to Landau's result when $t/\tau \ll 1$; it has an oscillatory behavior when t/τ is of order unity, and it phase mixes to zero as t/τ approaches infinity. The above results are all shown to have simple physical interpretations. (auth)

8232 COMPUTER EXPERIMENTS ON THE RANDOMIZATION OF ELECTRONS IN A COLLISIONLESS PLASMA. Burger, P.; Dunn, D. A.; Halsted, A. S. (Stanford Univ., Calif.). Phys. Fluids, 8: 2263-72 (Dec. 1965).

The large-signal, time-dependent behavior of a one-dimensional, collisionless plasma is simulated on a computer by calculating the trajectories of a large number of charge sheets in a one-dimensional space. The equations of motion of the charge sheets are calculated self-consistently with the electric fields that the charges themselves set up in the diode. A plasma is formed in the diode by the generation of electron and ion sheets at a constant rate in time and space. The velocity distribution, charge distribution, and potential distribution of the simulated plasma are investigated. Electrons and ions are generated with prescribed initial velocities. Because of the heavymass of the ions, the potential in the middle of the diode becomes positive with respect to the wall. The potential does not settle down to a d-c state, however, but exhibits fluctuations at the electron plasma frequency. It is shown that these r-f fluctuations randomize the velocities of the electrons. A clear similarity is shown between the effects of these r-f fluctuations and elastic collisions. (auth)

8233 CURRENT-DRIVEN INSTABILITIES IN CONFIGURATIONS WITH SHEARED MAGNETIC FIELDS. Coppi, B. (Stanford Univ., Calif. Univ. of California, San Diego, La Jolla). Phys. Fluids, 8: 2273-80(Dec. 1965).

A set of instabilities which are fastest in the weakly collisional regime, being slowed down by increasing electron-ion collisions, is presented. They take place in configurations having very low pressures, sheared magnetic field, and current flowing along it. These instabilities are driven by the transverse gradient of the longitudinal current, are connected with the effects of electron inertia, and characterized by two types of mode. Modes of one type are electrostatic and localized, having eddies of relatively short scale length, and exist for small and finite wavelengths. The other modes are nonelectrostatic, nonlocalized, and result from one which is singular in the hydromagnetic limit. These exist only for wavelengths of the order of the width of the plasma column, in which limit they are faster than the electrostatic type of modes. The relation between these instabilities and the known "tearing" resistive mode is studied. The growth rate of this is, in fact, increased by ion-electron collisions and corresponds to transfer of magnetic energy into plasma kinetic energy by decoupling the motion of particles and lines of force. A brief discussion of experimental results offering indication for the modes discussed above is given. (auth)

8234 EXCITATION OF HYDROMAGNETIC WAVES BY A GYRATING PROTON STREAM. Neufeld, Jacob; Wright, Harvel (Oak Ridge National Lab., Tenn.). Phys. Fluids, 8: 2281-7(Dec. 1965). (ORNL-P-409).

It is shown that hydromagnetic waves excited by a stream of protons gyrating around the lines of a static magnetic field (helical proton beam) result from superluminous and counterstreaming instabilities. Physical conditions under which hydromagnetic P and B instabilities can occur are investigated with particular reference to the intensities of the helical proton beam and the rate of growth of the excited waves. It is found that in some instances the qualitative behavior of instabilities is different for different beam intensities. When the beam is very tenuous, the hydromagnetic B instability has a lower rate of growth than the P instability. However, for larger beam intensities the B instability has the larger rate of growth. Therefore it represents the dominant instability. The applicability of the results of the investigation to the analysis of low frequency pulsations of the terrestrial magnetic field is discussed. (auth)

8235 NEGATIVE V'' ON A GENERAL MAGNETIC AXIS. Whiteman, K. J.; McNamara, B.; Taylor, J. B. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids, 8: 2293-5(Dec. 1965).

Superior hydromagnetic plasma stability properties have been attributed to vacuum magnetic fields in which $V'' = d^2V/dF^2 < 0$, where $V(\psi)$ is the volume enclosed by a magnetic surface ψ = constant which encloses longitudinal flux $F(\psi)$. This calculation of $V''(0)$ follows closely the work of Mercier (Nucl. Fusion, 4: 213 (1964)) on the determination of hydromagnetic equilibria in which the flux surfaces are expanded in powers of the distance ρ from the magnetic axis, $\psi = \rho^2\psi_2 + \rho^2\psi_3 + \ldots$. This work is concerned with the limiting case of Mercier's, but it is simpler and more illuminating to derive V'' directly for a vacuum field than to use the general theory of equilibria. If the axis is straight then $V''(0)$ can be expressed in terms of the lowest-order flux function ψ_2 only, but if the axis has a nonzero curvature then it is found that $V''(0)$ can no longer be defined solely in terms of ψ_2 but involves also a knowledge of ψ_3. (C.E.S.)

8236 INSTABILITY IN A HOT ELECTRON PLASMA. Ferrari, L. A.; Kuckes, A. F. (Princeton Univ., N. J.). Phys. Fluids, 8: 2295-7(Dec. 1965).

The production and magnetic confinement of hot electron plasmas in mirror geometries are discussed. The observation of an instability which initiates a rapid transport of plasma across the magnetic field lines in such a discharge is reported. This rapid transport occurs after the plasma has been quietly decaying for some time. The sudden onset of loss can be damped by the addition of cold electrons to the discharge. (C.E.S.)

8237 EXISTENCE OF PLASMA CYCLOTRON RESONANT HARMONICS. Hand, George L. (IKOR, Inc., Burlington, Mass.). Phys. Fluids, 8: 2297-8(Dec. 1965).

Higher harmonics of the cyclotron resonance frequency are shown to exist theoretically for an electromagnetic wave propagating through a plasma with a superimposed magnetic field. If the moment expansion of the Boltzmann equation is utilized then the highest order of the harmonic appearing in the derived dispersion relation is the same as the order of the highest moment of the Boltzmann equation used. It is shown that the n^{th} moment of the Boltzmann equation introduces the n^{th} harmonic. (C.E.S.)

8238 THIRD CHAPMAN-ENSKOG APPROXIMATION TO THE ELECTRICAL CONDUCTIVITY OF FULLY IONIZED GAS IN A MAGNETIC FIELD. Schweitzer, S.; Mitchner, M. (Stanford Univ., Calif.). Phys. Fluids, 8: 2300(Dec. 1965).

Closed-form expressions for the third Chapman-Enskog approximations to the electric conductivity of a fully ionized plasma in a magnetic field are obtained. (C.E.S.)

8239 ECHO PHENOMENA. Gould, R. W. (California Inst. of Tech., Pasadena). Phys. Lett., 19: 477-8 (Dec. 1, 1965).

Two mechanisms are pointed out by which echoes can arise in classical oscillator systems, and in particular in a system of gyrating charged particles, as in a plasma. The response of an ensemble of noninteracting charged particles to a pulsed electric field which rotates with a certain angular velocity about the axis of the static magnetic field is considered. The motion of an ensemble of oscillators in a phase space system which rotates with a certain angular velocity with respect to the origin system is described graphically. (J.F.P.)

8240 PLASMA DENSITY VARIATIONS IN A NONUNIFORM MAGNETIC FIELD. Ma, C. H.; Johnson, C. C. (Univ. of Utah, Salt Lake City). Proc. IEEE (Inst. Elec. Electron. Eng.), 53: 1751-2(Nov. 1965).

The results are reported of theoretical and experimental investigations of plasma density variations in nonuniform magnetic field. (L.B.S.)

8241 THE RADIAL DISTRIBUTION OF THE PARTICLE DENSITY IN ARC PLASMA. Vukanovic, Damjana (Inst. of Physics, Belgrade). Rev. Roum. Chim., 10: 719-25(Aug. 1965). (In German).

The radial distribution of the particle density of elements of different degrees of ionization in the plasma was observed in a free-burning arc by spectroscopy. The pattern of the radial distribution in the plasma was studied considering the probability that the particles would be found in a plasma zone in the neutral or ionized state and considering the mixing effect in the arc plasma. (tr-auth)

8242 INDUCED SCATTERING OF LANGMUIR OSCILLATIONS IN A PLASMA WITHIN A STRONG MAGNETIC FIELD. Shapiro, V. D.; Shevchenko, V. I. (Inst. of Physics and Tech., Academy of Sciences, Kharkov). Ukr. Fiz. Zh., 10: 960-8(Sept. 1965). (In Ukrainian).

A study is made of the nonlinear scattering processes of Langmuir oscillations on the electrons of a plasma located in a strong magnetic field. Expressions are found for the quantities, that define the rate of change in the spectral density of the energy of oscillations as a consequence of the scattering process. It is shown that in distinction to the previously considered case of a one-dimensional spectrum the change in the total energy of plasma oscillations in a strong magnetic field occurs in the lowest order with respect to $k^2\lambda_{De}^2$. The oscillation amplitudes for which nonlinear energy dissipation becomes substantial are found. (auth)

8243 PLASMA INVESTIGATION BY MEANS OF THE INTERFEROMETER AND MICROWAVE CUT-OFF METHOD. Dushin, L. A.; Kononenko, V. I.; Kovtun, R. I.; Privezentsev, V. I.; Skibenko, A. I. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukr. Fiz. Zh., 10: 997-84(Sept. 1965). (In Ukrainian).

A method is described for the study of plasma decay, which permits a simultaneous measurement of phases and amplitudes of signals transmitted through the plasma. The phases were measured at 136 Gc/s and the amplitudes at 136.74 and 37 Gc/s. A method for plasma diagnostics by means of signals with different frequencies is also presented. An approximation of the radial plasma density distribution by means of the $F = 1 - (r/R)^\gamma$ function is discussed (γ is estimated by the measured mean electron density and the maximum density decrease, R is the radius of the plasma cylinder). An estimate is also made of the relative contributions of recombination and diffusion to the plasma decay process. In the case where recombination is predominant, the recombination coefficient was determined, from which the electron temperature was deduced. A comparison of this temperature with the temperature value obtained by microwave attenuation indicates satisfactory agreement of both methods. (ATD)

8244 MULTIPLE ACCELERATION AND REFLECTION OF PLASMOIDS. Schindler, H. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Z. Naturforsch., 20a: 973-4(July 1965). (In German).

If an azimuthally directed plasma current is induced in the median plane of a cusp magnetic field, a Lorentz force arises in the axial direction through the interaction with the radial component of the magnetic field. The ring current together with the axial magnetic component causes a radial compression of the plasma. An accelerator operating according to this principle was constructed. The possibility of connecting two or more of this type of accelerator stages together in order to obtain multiple acceleration or plasma reflection was investigated. The principle of the two-stage accelerator is shown. Two mechanisms were investigated for postacceleration in the second stage. The results obtained with one of the methods—the plasmoid emitted from the first stage is captured in the second-stage cusp field and stored a short time, producing an increase of the electric conductivity—are reported and discussed. The positive results obtained with the connection of the two accelerator stages led to the incorporation of a third stage which is currently under study. (J.S.R.)

8245 QUASILINEAR RELAXATION OF LONGITUDINAL OSCILLATIONS OF A PLASMA. Sizonenko, V. L.; Stepanov, K. N. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksp. Teor. Fiz., 49: 1197-1210(Oct. 1965). (In Russian).

On basis of the quasilinear theory equations it is shown that for $t \to \infty$ a plateau appears in the distribution function of resonance particles under the action of three-dimensional longitudinal oscillations. Relaxation of the distribution function of electrons moving with respect to ions under the action of unstable ion-acoustic oscillations is considered. It is shown that if the electron velocity is close to the critical value above which the oscillations are unstable, the resonance electrons will be slowed down during the first stage of relaxation to a velocity of the order of that of sound. Subsequently a plateau is formed along the direction of the beam and the oscillation spectrum becomes one-dimensional. Quasilinear relaxation under the action of one-dimensional wave packets in a magnetic field is considered in detail. (auth)

8246 CYCLOTRON ABSORPTION AND HEATING OF A PLASMA. Andronov, A. A. (Gorkii State Univ.). Zh. Eksp. Teor. Fiz., 49: 1293-1303(Oct. 1965). (In Russian).

A nonlinear theory of cyclotron resonance in an homogeneous rarefied plasma is considered. The conditions for kinetic instability of the quasistationary state of a plasma in the electromagnetic field of a monochromatic plane wave is discussed. It is pointed out that such instability may be employed for turbulent cyclotron heating. An example is presented of resonance (continuous) acceleration of a nonrelativistic particle in the electromagnetic field of two plane waves. (auth)

8247 INTERACTION OF TRANSVERSE WAVES WITH A TURBULENT PLASMA. Kovrizhnkh, L. M. (Lebedev

Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 49: 1332-44(Oct. 1965). (In Russian).

A solution is presented for the boundary problem of propagation of a transverse wave signal through a finite plasma in which intense Langmuir or ion-acoustic waves of the nature of noise are excited with an arbitrary spectral distribution. The angular distribution of the intensity of the scattered waves is found and it is shown that its measurement may be employed as a method for diagnostics of plasma noise. (auth)

8248 INDUCED COMBINATIONAL SCATTERING OF LONGITUDINAL WAVES IN A MAGNETOACTIVE PLASMA. Kropotkin, A. P.; Pustovalov, V. V. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 49: 1345-61(Oct. 1965). (In Russian).

Decay interaction involving three longitudinal proper oscillations is studied by means of the nonlinear equation for evolution of field fluctuations in an homogeneous magnetoactive plasma. In the concrete particular cases of longitudinal spectra, expressions are obtained for the kernels of equations which describe such decay in an almost isothermal plasma. (auth)

8249 ON NONLINEAR FLUCTUATIONS IN A PLASMA WITH COULOMBIC INTERACTION. Giorgadze, N. P.; Silin, V. P. Zh. Prikl. Mekh. Tekh. Fiz., No. 3, 3-10 (May-June 1965). (In Russian).

The nonlinear fluctuations of a two-component plasma are studied analytically. The state of the plasma is expressed in terms of the phase density. This density is then represented as the sum of a mean density and a fluctuation term around this mean. The plasma is assumed to be quasi-neutral and a two-time correlation is defined. To estimate the fluctuations, an initial condition is given and the solution is carried out by taking the Fourier transforms of the density fluctuations with respect to time as well as the space coordinates. Equations are obtained which represent the two-time correlators of phase density in terms of correlation functions and represent the actual solution of the nonlinear problem. (ATD)

8250 VISCOSITY OF PLASMA IN A STRONG MAGNETIC FIELD. Aliev, Yu. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 3, 19-26(May-June 1965). (In Russian).

Under the assumption of a homogeneous constant magnetic field, the viscosity of plasma was studied under conditions where the magnetic field affects the process of particle stress using the linearized kinetic equation. It is shown that for sufficiently strong fields between electron and ion components of the plasma a temperature difference arises proportional to the shift velocity and logarithmically dependent on the strength of the magnetic field. The expressions obtained for the viscosity coefficients differ essentially from the coefficients obtained from the usual theory. (ATD)

8251 ISOTROPIC CORRECTIONS TO MAXWELLIAN FUNCTIONS IN A PLASMA AND THE RATE OF ENERGY EXCHANGE. Bisnovatyi-Kogan, G. S. Zh. Prikl. Mekh. Tekh. Fiz., No. 3, 74-6(May-June 1965). (In Russian).

The method of Chapman-Enskog is used to correct the Maxwellian distribution function for electrons and heavy particles in a partially ionized gas. The distribution function is given by $f_\alpha = f_\alpha^0(1 - F_\alpha)$ where $\alpha = 1,2,3$ corresponds to ions, electrons, and neutrals respectively. It is assumed that T_2 is different from $T_1 = T_2 = T$. The solution for F_α is given in terms of Sonine polynomials. The charged particle interaction is assumed to be given by Coulomb forces and the interaction between neutrals by a Lennard-Jones potential. The polynomials are used to calculate the energy exchange between particles to within a first order correction. (ATD)

8252 ROTARY MOTION AND DISTRIBUTION CHARACTERISTICS OF AN ARC COLUMN NEAR THE ELECTRODES IN A PLASMATRON WITH A GAS VORTEX STABILIZATION. Kolonina, L. I.; Smolyakov, V. Ya. Zh. Prikl. Mekh. Tekh. Fiz., No. 3, 80-4(May-June 1965). (In Russian).

The motion and distribution of an arc column in a vortex stabilized arc jet at constant current were investigated experimentally by means of high speed cameras. The details of the two arc jets used are shown. Motion pictures were taken 10-15 sec after striking the arc at a speed of 5000 and 125,000 frames per second through the transparent window. The photographs of the arc resemble a comma with the bulge towards the gas flow direction. The results show that in the pressure range 2-6 bar there is a jerky motion of the arc spot near the inside electrode with the radial part of the column on the electrode wall. Furthermore, the diameter of the arc near the axis is much larger than the diameter of the arc in the radial direction. This difference is explained by means of the peculiar distribution of the column in the exit electrode. The rotation rate of the arc was found to be quite steady, with a maximum deviation of 20%. From the brightness magnitude of the arc spot diameter the current density in the arc spot as well as the specific energy flow were estimated. At 5 bar pressure and 50-150 amp current the specific energy flow was estimated to be between 0.6×10^9 and 2.5×10^9 volts/m^2. (ATD)

8253 PLASMA DIAGNOSTIC TECHNIQUES. Huddlestone, Richard H.; Leonard, Stanley L. (eds.). Pure and Applied Physics. A Series of Monographs and Textbooks. Volume 21. New York; London, Academic Press, 1965. 639p. $19.50; 156s.

The book included 11 chapters. Separate abstracts were prepared for each chapter. (J.F.P.)

For abstracts of individual chapters see: 8254–8264

8254 BASIC MACROSCOPIC MEASUREMENTS. Leonard, Stanley L. (Aerospace Corp., Los Angeles). pp. 7-67 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

Brief discussions of the techniques for observing or measuring some of the large-scale properties of plasmas are presented. These properties include the total current through the plasma, the total voltage across it, the average electric conductivity, the total plasma momentum, the total radiation from the plasma, and the physical size and motions of the luminous regions of the plasma. Also some related techniques are discussed which yield information about local conditions at points inside the plasma. Examples of these are the schlieren and shadowgraph variations in the first and second derivatives of the electron density. Piezoelectric pressure probes are also discussed. Some methods of making local heat conductivity measurements are mentioned briefly. (J.F.P.)

8255 MAGNETIC PROBES. Lovberg, R. H. (Univ. of California, San Diego, La Jolla). pp. 69-112 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London Academic Press, 1965.

Probes of the inductive loop variety are considered only, since this method has been almost exclusively used thus far. The typical magnetic probing system is considered, and its components and the parameters which influence its performance are discussed. Several examples of data obtained by this means are presented together with the conclusions drawn from them. Mutual perturbations of the probe and plasma are treated, in order to delimit the regimes of magnetic probe applicability. (J.F.P.)

8256 ELECTRIC PROBES. Chen, Francis F. (Princeton Univ., N. J.). pp. 113-200 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

The available theoretical results are summarized for electric probes, with a sketch given of the way in which they were obtained whenever possible. This is supplemented with practical information on experimental techniques. A short introduction to the physical notion of sheath is given, and a well-documented theory of probes in a collisionless plasma is presented. The theory of probes in the presence of collisions and magnetic fields is treated, although it is still in the primitive state.

Specialized techniques and practical considerations in the use of electrostatic probes are described. (J.F.P.)

8257 SPECTRAL INTENSITIES. McWhirter, R. W. P. (United Kingdom Atomic Energy Authority, Abingdon, England). pp. 201-64 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

Various methods for taking account of the numerous possible atomic processes to give a composite picture of the spectrum are considered. The development of the models discussed owes much to astrophysics. But since laboratory plasmas are transitory, time-dependent rather than steady-state solutions are sought. Line and continua intensities are considered. After a discussion of theoretical plasma models, the various methods of spectroscopic diagnosis depending on measurements of spectral intensities are reviewed. The ranges of the applicability and reliability of the methods are assessed in this context. The methods discussed give estimates of one or more of the following plasma parameters: electron temperature, electron density, and impurity concentration. (J.F.P.)

8258 LINE BROADENING. Wiese, W. L. (National Bureau of Standards, Washington, D. C.). pp. 265-317 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

Applications of line-broadening theory to plasma diagnostics are given, based on recent theoretical developments. Since this objective requires the discussion of line broadening from a practical point of view, the physical content of recent theories is only briefly sketched, but the availability of numerical data as well as the reliability of the theoretical results and the applications to plasma diagnostics are extensively discussed. It is noted that the measurement of Stark half-widths is one of the most reliable and convenient methods for the determination of electron densities. (J.F.P.)

8259 OPTICAL AND ULTRAVIOLET TECHNIQUES. Turner, Eugene B. (Aerospace Corp., Los Angeles). pp. 319-58 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

The experimental techniques, including instruments, detectors, and calibration methods, that are required to obtain data on spectral lines and intensity broadening for plasma are considered. The spectral range considered includes a wavelength of about 10,000 Å, the longest of which is still accessible to photographic film and phototubes, to a wavelength of only a few tens of angstroms, where the soft x ray region begins. The general requirements of spectroscopic instrumentation for plasma diagnostics, and the spectroscopic instrumentation for the photographic infrared, visible, and near ultraviolet spectral regions where the instruments and techniques are similar, are described. The instrumentation for the vacuum ultraviolet region, photographic film and plates, multiplier phototubes, and methods of calibrations are also discussed. (J.F.P.)

8260 X-RAY SPECTROSCOPY. Stratton, T. F. (Los Alamos Scientific Lab., N. Mex.). pp. 359-97 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965. (LADC-6208).

X-ray spectroscopy for plasma is discussed. This discussion includes the spectral region and radiation characteristics, continuum radiation, line radiation, and special properties of the source. Diagnostic techniques are considered including absorption methods, monochromators, detectors, and x-ray calibration sources. Bremsstrahlung and recombination intensity, population ratios for states of ionization, relaxation times and wavelengths are also considered. (J.F.P.)

8261 FAR-INFRARED TECHNIQUES. Kimmitt, M. F.; Prior, A. C.; Roberts, V. (Royal Radar Establishment, Great Malvern, Worcestershire, England). pp. 399-430 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

A brief review is given of the present state of the theoretical treatment of the emission of radiation from plasmas as it applies to the far infrared. A general survey of relevant infrared techniques is given, and the applications to actual plasmas is discussed. Topics covered are emission properties of plasmas in the far infrared, spectroscopic instrumentation for the far infrared including vacuum grating spectrometers, interferometers, detectors, radiation sources, far-infrared optical components, and detection capability. Emission measurements on plasmas are also considered. (J.F.P.)

8262 OPTICAL INTERFEROMETRY. Alpher, Ralph A.; White, Donald R. (General Electric Lab., Schenectady, N. Y.). pp. 431-76 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

The theory of optical refractivity of plasmas is discussed. This discussion includes the refractive index, optical frequencies, the electron component, group and phase velocity, sensitivity as a function of frequency, refractivity of nonelectronic species, two-wavelength interferometry, and other refractivity effects. Verification of plasma interferometry is discussed including the spark channel, the conventional shock tube, electromagnetic shock tube, and steady discharge. Experimental procedures are described. These are types of interferometers, light sources, offset interferometry, two-wavelength recorking, time-resolved interferometry, infrared interferometry, laser interferometry, and analysis in axisymmetric geometries. Applications are also considered covering shock tubes, discharges, exploding wires, fusion plasma devices, and nonterrestrial applications. (J.F.P.)

8263 MICROWAVE TECHNIQUES. Wharton, Charles B. (General Dynamics Corp., San Diego, Calif.). pp. 477-516 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

Some of the simpler cases of plasma and wave interactions are treated. From these, conclusions can be drawn concerning complicated cases, either by scaling or by approximations and intuition. Wave interactions in a cold, uniform plasma, wave propagation in a temperate plasma and through bounded plasmas, and space-charge waves in plasma are considered. Also plasmas contained on resonant cavities, wave-propagation techniques and experiments, microwave radiation from a plasma, and radiometers for radiation experiments are discussed. (J.F.P.)

8264 PARTICLE MEASUREMENTS. Osher, J. E. (Aerojet General Nucleonics, San Ramon, Calif.). pp. 517-601 of Plasma Diagnostic Techniques. Richard H. Huddlestone; Stanley L. Leonard (eds.). New York; London, Academic Press, 1965.

Various diagnostic techniques are described which involve relatively direct measurements of the particles constituting the plasma under study. The description of these techniques includes measurements of ions and electrons in or leaking from the plasma volume, and indirect measurements by means of particle or particle-like interaction with the particles of the plasma. A brief description of specific techniques, the range of applicability, and some typical problems of the measurements are presented. These include examples and graphs or brief tabulations of some of the more general physical properties necessary to apply such diagnostics to a specific experiment. In general, laboratory plasmas are taken to be the primary area of application, with lesser application to space physics problems. The techniques on particle measurements tend to be most applicable to relatively energetic plasmas. (J.F.P.)

8265 THE PLASMA DYNAMICS IN WALL STABILIZED ARCS [Thesis]. Pratt, H. -J. Aachen, Tech. Univ., 1964. 146p. $2.00 Gmelin, AED-DISS. 64-742.

The properties of the plasma in an arc discharge are calculated using equations which are simplified by the assumption that no space charges occur. The boundary conditions determine the geometry of the arc. A semi-infinite cylindrical tube containing an arc is considered. Thermal interaction with a circulating gas entering at the tube face is calculated. (Gmelin Inst.)

8266 DESCRIPTION OF A PLASMA WITH DIFFERENT PARTICLE COMPONENT TEMPERATURES [Thesis]. Kroell, W. Bonn, Univ., 1964. 41p. $2.00 Gmelin, AED-DISS. 64-732.

A mathematical description of the statistical behavior of a plasma with different particle component temperatures is given. For the phenomenological description of the plasma methods of irreversible thermodynamics are used. An ionization formula is given for a plasma with linear deviations from the Maxwell distribution. (Gmelin Inst.)

8267 IONIC WAVE PROPAGATION IN PLASMAS [Thesis]. Welt, Martin Allan. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1965. 126p.

Ultrasonic quartz crystals in the 15.5 to 45.8 megacycle per second frequency range were used to excite ionic longitudinal waves in low pressure (1.0 to 8.5 mm Hg) argon and helium plasmas. The ion densities were in the range of 10^{10} to 10^{11} electrons per cm^3. An ultrasonic interferometer was specially designed and used to measure the ionic wave attenuation, which was found to be about 1–5 db per cm, and the ionic wave velocity, which varied between 2×10^5 and 2×10^6 cm per sec. The experimental results were compared with a three-fluid dispersion relation developed in this study and correctly revealed a decrease in wave absorption with increasing frequency and a relative insensitivity to the molecular weight of the neutral gas. The magnitude of the experimental attenuation appeared to agree with the theoretical predictions. (Dissertation Abstr.)

8268 INFRARED MASER INTERFEROMETRY FOR TIME AND SPACE RESOLUTION OF ELECTRON DENSITY IN HIGH TEMPERATURE PLASMAS [Thesis]. Gribble, Robert Fonda. Austin, Tex., Univ. of Texas, 1965. 134p.

A 3.39 μ He–Ne maser-excited infrared interferometer was utilized for the investigation of time- and space-resolved electron density in a high-temperature, dense plasma formed in the "theta-pinch" geometry. Dispersion of the coherent infrared radiation by the plasma electrons within an external resonator pulls the frequency of the coupled maser resonator with a resultant change in intensity. A spherical mirror focuses the maser beam at the center of a 20 cm length coil. The external resonator is formed by placing a second spherical reflector at a distance from the center of the plasma equal to the reflector's radius of curvature. This spherical reflector returns the maser beam upon itself. The resonators are operated with low coupling and at a relatively low Q. The maximum measurable electron density time variation of 3×10^{16} cm^{-3} sec^{-1} is achieved with a fast In As infrared detector. Use of a still faster PEM infrared detector will extend this measurement technique to 2×10^{17} cm^{-3} μsec^{-1}. Time-space resolved electron density was obtained for compression to 50 kG with a forward bias of 4 kG at an initial D_2 pressure of 0.1 torr. A peak density along the tube axis of 6×10^{16} cm^{-3} was measured here where there was no evidence of a "snowplow" effect. Fast magnetic compression of plasma immersed in a reverse bias field presented several difficulties in the measurement as compared to that of forward bias due to the extraordinary differences between the dynamical behavior of the two classes of plasmas. Time-space resolved electron density was obtained for compression to 15 kG at 0.05 torr for 6 kG reverse bias. At the center of the plasma there was observed a spatial density minimum that lasted over the full half-cycle of the compressing field, indicating a trapped reverse bias field. There was also observed a definite radial shock structure traveling greater than 5 cm μsec^{-1} directed to the tube center. This shock was followed within 1 μsec by a radial contraction of the "hollow" plasma column to a diameter of 1.6 cm. (Dissertation Abstr.)

8269 RADIATION FROM A VERTICAL ELECTRIC DIPOLE IN A WARM PLASMA ABOVE A CONDUCTING PLANE [Thesis]. Langelier, Robert Michael. Lafayette, Ind., Purdue Univ., 1964. 168p.

The radiation characteristics of a vertical electric dipole situated in a homogeneous, warm plasma half-space above a perfectly conducting plane is considered. The problem is formulated in terms of two vector potential functions; one is used to represent the e mode, while the other is used to represent the p mode. The potentials are expressed in terms of their Fourier integral representations and the formal solution is found first by classical boundary matching techniques and then by the use of signal flow graphs. An asymptotic series expansion is obtained for the resulting integrals by the double saddle point method of integration. The dominant terms of the solution in the far field are shown to consist of a surface wave, which arises from the residue of a pole, and a space wave, which is the leading term of the saddle point contribution. The space wave is identified as the geometrical ray approximation to the solution. It is demonstrated that the surface wave can propagate when the source frequency is either above or below the plasma frequency. The transfer of energy from an incident p to a boundary-generated e mode and from an incident e to a boundary-generated p mode is investigated at a plasma-conductor interface. It is evident in both situations that only a small percentage of the incident energy is transformed into the boundary-generated mode. In the case of a vertical dipole however, it is shown that at source frequencies near to the plasma frequency the energy in the p mode is much larger than that in the e mode and thus the boundary-generated e mode due to the incident p mode is as large as the reflected e mode due to an incident e mode. As a result of this effect, it is pointed out that one can represent the reflected e mode by two image sources. Finally, the general problem of radiation from a source in a two-fluid model of a plasma with damping is investigated. It is indicated that problems in this type of model can be treated in a fashion similar to those in a one-fluid model. (Dissertation Abstr.)

8270 THE IONIC AND RADIATIVE EMISSIONS AND CONDUCTIVE BEHAVIOR OF TRANSIENT PLASMAS IN VACUO [Thesis]. Manka, Charles Keith. Little Rock, Ark., Univ. of Arkansas, 1965. 99p.

Transient plasmas were created in vacuo and the positive ion temperature, flow velocity, and possible containment time for the plasma were determined by an analysis technique that rests principally on the assumption of free molecular flow in the evacuated drift tube and on the assumption of a translationally equilibrated plasma. The plasma was created by introducing neutral argon gas into an evacuated discharge head having a central probe held at about 1200 volts with respect to the walls. An energy storage capacitor, which delivered energy to the plasma, was hooked between the probe and the walls. The neutral gas ionized causing a discharge of the capacitor, which in turn produced the plasma. Ions were injected into the drift tube. The positive ion current was measured as a function of time at several biased pickup plates located at various distances down the drift tube. The resulting curves were analyzed using the above assumptions. With input energies at about 30 joules, excellent agreement between data and the ad hoc theory was obtained. Plasmas created by exploding gold wire were investigated and data and theory compared favorably. Spectra were obtained from gold plasmas and argon plasmas to investigate their degrees of ionization and check the assumptions of 100 per cent single ionization, respectively. The time dependence of individual spectral lines was obtained. Two unusual effects were noted. The first was a cessation and restrike of the current through the argon discharge which was similar to the "current-dwells" observed in exploding

wires. Second, in time dependence measurements, the emission of 4348.1 Å ionized argon line was observed to be curiously suppressed during the third half-cycle of current through the discharge. (Dissertation Abstr.)

8271 ALICE "B" CIRCULATING LN TRAPS (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Livermore). (CAPE–1262).

26 drawings.

Liquid nitrogen, cold traps used for ultrahigh vacuum systems employing diffusion pumps are described. The traps have two important functions: to prevent diffusion pump fluid from entering the high vacuum chamber by providing an optically dense arrangement of cold surfaces for condensation of the fluid; and to enable the diffusion pump to be isolated from the system during start-up of the pump. No fluid drops are regurgitated into the trap which keeps the trap clean and therefore a more effective condenser during normal operation. The trap is designed for the ALICE, a device used to study stable confinement in thermonuclear research. (For details, see TID-4100). (L.B.S.)

Shielding

Refer also to abstract 7674.

8272 (DESY–65/6) ELEKTRON-PHOTON-KASKADEN IN BLEI FUER PRIMAERTEILCHEN DER ENERGIE 6 Gev. (Electron-Photon Cascade in Lead Due to Primary Particles of 6 Gev). Voelkel, U. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). July 1965. 90p. Dep. mn.

An electron-photon cascade in lead owing to primary particles of 6 Bev was calculated using a Monte Carlo method. Electrons and photons were chosen as primaries. The following quantities were calculated; particle spectra, particle angular and radial distributions, and energy distribution in the material. A comparison of these results with experimental data for primary electrons of 100 to 1000 Mev shows that spectra (after proper normalization) and angular distributions (with some reservations) are not dependent on primary energies up to 6 Bev. (auth)

8273 (LA–3401) ON FREQUENCY DISCRETIZATION AND CONSERVATIVE DIFFERENCE EQUATIONS FOR RADIATIVE TRANSFER. Wendroff, Burton (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Sept. 20, 1965. Contract W-7405-eng-36. 18p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The method of characteristics is generalized to obtain completely conservative difference equations that are approximations to the transport equation. A method of frequency discretization, which allows retention of a large part of the information that is lost if the absorption coefficient is simply averaged, is proposed. It is shown that the difference equations behave correctly in the limit of large or small absorption coefficient. (auth)

8274 (LNF–65/30) CALCOLO DI UNA CASCATA NUCLEONICA IN ALLUMINIO CON IL METODO DI MONTE CARLO PER ENERGIE TRA 400 E 30 MEV. (Calculation of a Nucleon Cascade in Aluminum with the Monte Carlo Method for Energies Between 400 and 30 Mev). Note No. 287. Locci, M. A.; Picchi, P.; Verri, G. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Sept. 6, 1965. 12p. Dep. mn.

A nucleon cascade generated by fast primary nucleons with a maximum energy of 400 Mev was studied with the purpose of attaining information for the evaluation of the necessary thicknesses for the shielding of the Frascati linear accelerator. The calculation of the cascade was followed in a monodirectional approximation. In the energy range considered, the meson component of the cascade was neglected. In the calculations Al is used as the absorbent, as it is the element having characteristics closest to that of cement normally used for shielding. The program, however, can be used for any absorbing medium. The calculations were performed with a FORTRAN program. The program was written for the IBM-7040. The results are given graphically. (J.S.R.)

8275 DOUBLE-P_1-APPROXIMATION FOR GAMMA-RAYS. Gerstl, S. A. W. (Technische Hochschule, Stuttgart). Atomkernenergie, 10: 432-5(Nov.-Dec. 1965). (In German).

The solution of the one-dimensional energy and angular dependent transport equation is discussed for the differential energy flux of gamma rays emanating from a plane, monoenergetic source of arbitrary angular distribution into a slab of finite thickness. The method of double P_1-approximation is applied to the problems of gamma transport. With this, two fundamental advantages over the usually applied methods for the calculation of the penetration of gamma rays in a finite slab are shown. The principal difference between the common P_1-approximation and the modified calculational method is discussed. Numerical results were carried out for a double-P_1-approximation; its accuracy approaches that of a common P_5-approximation. Besides the energy spectra at points inside the slab also the spectra of transmitted and reflected energy flux are presented and compared with Monte Carlo calculations. (auth)

8276 SIMILARITY PRINCIPLES FOR THE PASSAGE OF ELECTRONS THROUGH THICK LAYERS OF MATERIALS. Harder, D. (Univ., Wuerzburg, Ger.). Biophysik, 2: 381-3(1965). (In German).

In order to facilitate a survey over the interaction of electron losses and direction changes in the passage of electrons in thick materials, it is necessary to look for simple regularities for the transport phenomena occurring. Similarity principles are derived for the reduced Fokker-Planck equation. Experimental results show the principles are valid to good approximation under 20 Mev. (J.S.R.)

8277 AN ANALYSIS OF THE J-DISCONTINUITY IN SCATTERED X-RAYS. PART III. Pal, Hirendra Kumar (Calcutta Univ.). Indian J. Phys., 39: 283-96(June 1965).

The cause of a discontinuity of the second kind is discussed, which constitutes a significant feature of the J-phenomenon. It was shown that the occurrence of this discontinuity and the associated characteristics may be accounted for in terms of an irregular fluctuation of the percentage modification during scattering. A possible interpretation was also suggested for the "levels" of x-ray activity postulated by Barkla. (auth)

8278 MULTIPLE SCATTERING STREAMING OF GAMMA-RAYS THROUGH CYLINDRICAL DUCTS. Tsuruo, Akira (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Tech. (Tokyo), 2: 406-9(Oct. 1965).

A semi-analytic Monte Carlo calculation was applied to the duct streaming problem. The first positions of collision of photons are selected systematically in a certain volume surrounding the duct, and further scattering positions determined by the random walks of the photons. The expectation value that the photons arrive at the duct exit from their scattering point are integrated over the volume. The multiple scattering doses through ducts surrounded by a lead and water shield are presented. The ratio between scattered and unscattered dose is about 40% for duct in water when $E_0 = 1$ Mev and $L/R_0 = 10$; the ratio decreases with increase of E_0 and L/R_0. It also decreases with increasing atomic numbers of the shield materials. A large part of the scattered dose consists of once scattered photons. The statistical deviation of the calculated dose is about 5% for 6,000 ~ 8,000 histories, when the relative dose attenuation is of the order of 10^{-6}. The buildup factors of γ-rays from a point isotropic source for a slab shield are also obtained using the above method; the results agree well with those by the moments method. (auth)

8279 ATTENUATION OF GAMMA RADIATION FROM CYLINDRICAL SOURCES IN HOLLOW CYLINDRICAL SHIELDING. Abrams, I.; Veveris, O.; Godkalns, A.; Kalis, H. (Inst. of Physics, Academy of Sciences, Latvian SSR). Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser., No. 5, 26-34(1965). (In Russian).

A method is described of calculating the attenuation function of gamma radiation from cylindrical sources in hollow cylindrical shielding. The calculation was carried out on a computer, and the results are presented in the form of tables. The possibility of calculating the dose rate behind shielding, taking into account multiple gamma scattering in the shielding material, is also demonstrated. (auth)

8280 EXPERIMENTAL STUDY ON THE PENETRATION OF ^{60}Co PARALLEL γ-RAYS THROUGH SOME HETEROGENEOUS MATERIALS. Kanamori, Yoshihiko; Yokota, Toshiaki (Mitsui Shipbuild, and Eng. Co., Ltd., Japan). Mitsui Zosen Giho, No. 45, 20-6(Jan. 1964). (In Japanese).

The penetration of ^{60}Co parallel γ-rays through some double and triple layers was studied by the same method described in a previous report. The materials studied are lead, iron, aluminum and ordinary concrete. By comparing experimentally gained dose buildup factors of composite barriers with calculated values, some applicable conclusions are derived. To get the buildup factors of double layers composed of lead and the lighter materials, Kalos' equations are applicable. In this case, values for water are replaced by those for the light material. Especially, when lead is backed by the lighter material, multiplication methods are also applicable in practical estimation. For multiple layers composed of materials whose buildup factors are nearly equal, good practical results are obtained by using the largest of those buildup factors. The buildup factors of the triple layers are affected by the last materials, and practical approximate values are derived from the double layers. (auth)

8281 SOME CONSIDERATIONS OF BUILDUP FACTORS IN γ RAY PENETRATION FOR MULTIPLE LAYERS. Kitazume, Mitsuyuki (Hitachi Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 7: 496-8(Sept. 1965). (In Japanese).

The empirical Kalos equation for calculating the buildup factors for gamma ray penetration through multiple layers was used as the standard to which several theoretical treatments were compared. Calculations were based on 1-Mev gamma ray energy. When two light layers form the shielding material, the additional method gives values that are considerably divergent from the Kalos values. The light-heavy material values also are poor but improve with increasing thickness of the heavy layer. The multiplication method values for light-heavy layers improve with decreasing thickness of the light layer. When heavy-light layers are involved, the agreement becomes worse the thicker the heavy layer. The agreement of the values calculated by the mean free path method is much better for heavy-light layers than with the multiplication method particularly as the light layer becomes thinner. On the other hand, there is about 50% divergence when gamma rays pass from light to heavy layers. The values derived by the average atomic weight method are satisfactory when heavy-light layers are considered, but the reverse light-heavy assembly gives very poor agreement. When the Kalos values are compared with the values obtained by the Broder empirical equation, the agreement for the heavy-light layers case was within 30%. The two sets were rather discordant when the gamma rays were passed through light-heavy layers. The Broder equation was modified to compensate for this divergence. This last equation can be adapted for multiple layers greater than three. (TTT)

8282 THE EFFECT OF PIPES ON GAMMA-RAY DOSE RATE IN A NUCLEAR REACTOR SHIELD [Thesis]. Leggett III, Wilson Durward. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1964. 95p.

Experiments were conducted in the removable irradiation facility of North Carolina State Reactor-3 to determine the effect of pipes on the gamma-ray dose rate in a radiation shield. Iron pipes of varying lengths, diameters, wall thicknesses, and geometrical arrangements were studied. A 1-in. by 1-in. NaI(Tl) crystal was used as a detector and the measured scintillation spectra unfolded to yield gamma-ray dose rate and information on the energy distribution of gamma rays. An analytical model was formulated, which conservatively predicts the effect of the pipes for practically all situations examined, given dose attenuation in the unperturbed shield and unperturbed dose angular distribution at the point at which the pipe exit is to be located. (Dissertation Abstr.)

8283 STUDIES OF THE BACKSCATTERING OF γ RADIATION [Thesis]. Koch, S. Dresden, Tech. Univ., 1964. 123p. $2.00 Gmelin AED-DISS. 64-750.

Dependence of γ-ray albedo on the properties of the scatterer is studied using various radioisotopes as sources. Spectra of backscattered quanta are given. Results indicate that albedo increases with scatterer thickness and that for small quantum energies backscattering is independent on densities. (Gmelin Inst.)

Solid State Physics

See also CHEMISTRY — Inorganic and Physical Chemistry
METALS, CERAMICS, AND OTHER MATERIALS — Properties and Structure

Refer also to abstracts 7065, 7632, 8063, and 8119.

8284 (IS-T-49) SELF-CONSISTENT CALCULATIONS OF THE ELECTRONIC ENERGY BAND STRUCTURE OF Mg_2Si [Thesis]. Folland, Nathan Orlando (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 125p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Attempts were made to calculate the Hartree-Fock (HF) electron energy bands for the semiconducting compounds Mg_2Si as accurately and with as few approximations as practical considerations allowed. The finite crystal is defined by specifying the positions and charge of nuclei within a parallelepiped whose edges are the vectors $\{N\underline{a}_i\}$, i = 1,2, 3, where $\underline{a}_i$ is a primitive lattice vector and N is an integer. A sufficient number of electrons is added to neutralize the nuclear charge. The many-electron hamiltonian is derived from a periodically extended model (ECM) in which each ECM cell is identical to a finite crystal. The potential due to nuclear electronic charges separately are required to satisfy Poisson's equation, to be periodic with periods $\{N\underline{a}_i\}$, i = 1,2,3, and to average to zero over an ECM cell. Results are presented from self-consistent calculations for the SECM-HF and ECM-HF IPMs based on 64 and 8 point samples of the Brillouin zone, respectively. The wave functions were expanded in a mixed basis set of tight-binding (core) functions and about 65 plane waves orthogonalized to the core functions. The effect of distant ions on the core functions was approximated by a Madelung shift of the core energies. The error in the core energies made in this approximation was estimated to be less than .2 Ry. The form of the bands was the same for both the SECM and ECM calculations. The experimental prediction that the conduction band minimum occurs in the (100) directions was confirmed. Agreement with the energy gap was obtained within the estimated uncertainty of the core energies. An alternative formulation along similar lines is suggested in which these difficulties are reduced appreciably. (P.C.H.)

8285 (LA-3354) AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. IX. PREPARATION OF TABLES FOR PUBLICATION. Cady, Howard H. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). July 1965. Contract W-7405-eng-36. 66p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Two computer programs are described that edit the output data from the program GENLES to prepare tables for publication. The first program, EDTHKL, orders the reflections on $\underline{h}$, $\underline{k}$, or $\underline{l}$ and lists $|F_o|$, F_c, and, for noncentric structures, the phase angle alpha. The second program, EDTLES, identifies and lists all of the least-squares pa-

rameters and their standard deviations. The output of both programs is suitable for photographic reproduction. (auth)

8286 (NP-15590) ANISOTROPIC s-f INTERACTION IN RARE EARTH METALS. Kasuya, Tadao; Lyons, D. H. (Tokyo Univ. (Japan). Inst. for Solid State Physics). Sept. 1965. 55p. Dep. mn.

A detailed treatment of the s-f interaction, based on the free electron model, is presented, and also the fundamental method is established. The exchange part of the s-f interaction is considered, and the indirect coupling of the localized moments and lifetime of conduction electrons for the perfect paramagnetic state are calculated. The usual screened Coulomb interaction is used in treatment of direct terms in s-f interactions. (P.C.H.)

8287 (ORNL-P-1701) THE SCINTILLATION PROCESS IN NONACTIVATED ALKALI HALIDES. Murray, R. B. (Oak Ridge National Lab., Tenn.). Sept. 1965. Contract W-7405-eng-26. 35p. (CONF-650951-1). Dep. mn; CFSTI $2.00 cy, $0.75 mn.

From International Luminescence Symposium on the Physics and Chemistry of Scintillators, Munich.

The properties of this intrinsic luminescence in nonactivated alkali halide crystals are reviewed, and recent experiments with alkali iodide crystals which indicate that the scintillation luminescence in the pure crystal arises from the recombination of an electron with a self-trapped hole are described. This recombination process results in an exciton state (electron bound to self-trapped hole) in which the lattice preserves the axial distortion along a ⟨110⟩ axis characteristic of the trapped-hole center. This effect was demonstrated experimentally through the polarization of luminescence from oriented self-trapped holes. (P.C.H.)

8288 (BNL-tr-4) DYNAMIC POLARIZATION OF DEUTERONS IN A LANTHANUM-MAGNESIUM NITRATE CRYSTAL. Lushikov, V. I.; Taran, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Stephen Amoretty (Brookhaven National Lab., Upton, N. Y.), from report JINR-P-2007. 1965. 7p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf.

A single crystal of $(La-1\%\ ^{142}Nd)_2Mg_3(NO_3)_{12}\cdot 24(H_2O-42\%\ D_2O)$ (i.e., lanthanum magnesium nitrate containing ^{142}Nd and D_2O) is produced. The solid-effect method is used for dynamic polarization in the crystal at 1.4°K. The NMR spectrum and relaxation of the NMR signal of the deuteron in this crystal are measured at 6.5 Mc. (T.F.H.)

8289 THE PRINCIPLE OF THE MINIMUM ENTROPY PRODUCTION IN CONDUCTIVITY ELECTRON RESONANCES. Constantinescu, Florin (Babes-Bolyai Univ., Cluj). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 467-73(1965). (In Rumanian).

If no magnetic fields are acting on a system subject to an irreversible process and the phenomenological coefficients conform to Onsager's reciprocity relations, the stationary state is characterized by a minimum entropy production in comparison with the other states of the system, compatible with thermodynamic forces. The validity of this principle was examined in the case of electron spin resonance phenomena, using the Fermi-Dirac distribution for the carriers of paramagnetism. In the electron conductivity resonances in metals the low-level spins are coupled and are not able to contribute to the magnetic moment of the conductor; only states close to the Fermi level contribute to this moment. Some of the electrons of the metal may exhibit paramagnetic resonance. Using the method of T. W. Griswold et. al. (Phys. Rev. 88, 951 (1952)), the principle of minimum entropy production was verified for the case of $\rho = \beta H/kT \ll 1$; this condition was verified in electron spin resonance experiments. The resonance experiments were carried out at magnetic fields of H = 3400 gauss and normal temperature T = 300°K, yielding a result of $\rho \approx 10^{-3}$, satisfying the principle of minimum entropy production. This suggests that methods used in thermodynamics and irreversible process statistics may be applied to the resonance phenomena of the conductivity electrons in metals. (TTT)

8290 PHYSICS OF THE MOESSBAUER EFFECT. Eyges, Leonard (Air Force, L. G. Hanscom Field, Mass.). Amer. J. Phys., 33: 790-802(Oct. 1965).

The Mössbauer effect, i.e., the "recoilless emission" of gamma rays from a nucleus bound in a crystal lattice is considered from a simple physical point of view. It begins with a discussion of the kinematics of gamma-ray emission from such a nucleus. The idealized case of a massive "lattice" characterized by a single frequency and the more realistic one and three-dimensional models are treated. The fact that in the Mössbauer effect the lattice as a whole (the lattice center of mass) always recoils after photon emission, so that the term "recoilless emission" is in one sense misleading is noted. It is emphasized that the essence of the Mössbauer effect is not photon emission without recoil, but rather is photon emission without transfer of energy to internal degrees of freedom of the lattice. Using the basic ideas of quantum mechanics, namely, the rules for the manipulation of probability amplitudes (the so-called "transformation theory"), the probability for recoil without excitation of internal degrees of freedom, i.e., the Mössbauer f factor is calculated on the assumption that the individual photon emissions, and consequent lattice recoil, are instantaneous. This question of instantaneous emission is discussed in some detail, and it is shown how it is not in contradiction with the fact that the nuclear transition that leads to the gamma-ray emission has a finite half width. The rules of transformation theory that are used are summarized. (auth)

8291 LASER OSCILLATIONS AND SELF Q-SWITCHING IN TRIPLY ACTIVATED GLASS. Gandy, H. W.; Ginther, R. J.; Weller, J. F. (Naval Research Lab., Washington, D. C.). Appl. Phys. Lett., 7: 233-6(Nov. 1, 1965).

The results of pulsed xenon flash-lamp excitation experiments are described using confocal barium crown glass etalons triply activated with UO_2^{2+}, Nd^{3+} and Yb^{3+} at liquid nitrogen temperatures. By preferentially eliminating flash-lamp radiation absorbed by the UO_2^{2+} ions normal laser oscillations were induced in either Nd^{3+} or Yb^{3+} or in both ions during the same excitation pulse by varying the electrical parameters of the flash-lamp circuit. By using unfiltered flash-lamp radiation, the possibility of self Q-switching either Nd^{3+} or Yb^{3+} or both during the same excitation pulse by controlling the flash-lamp circuit constants was also shown. (L.B.S.)

8292 STUDY OF DEFECT STRUCTURES IN BeO SINGLE CRYSTALS BY X-RAY DIFFRACTION TOPOGRAPHY. Austerman, S. B. (Atomics International, Canoga Park, Calif.); Newkirk, J. B.; Smith, D. K. J. Appl. Phys., 36: 3815-22(Dec. 1965).

X-ray diffraction topography methods and supplementary optical microscopy were used to examine pyramidal and prismatic BeO crystals grown from lithium molybdate flux. The crystals appeared to have a high degree of perfection in that few dislocation lines were observed. Several specific types of defect structures were observed, however, in most of the crystals studied. The inversion-twin core structure was visible by image contrast effects from the twin boundary as well as by unequal image contrast on either side of the boundary. A screw dislocation line, possibly a group of many dislocations, commonly was present in the core and ran the full length of the crystal. Growth strata parallel to the active growth surfaces were also present. The topographs also revealed that considerable surface damage can be inflicted by intercrystal abrasion, much of which is removed by thermal annealing. (auth)

8293 FARADAY ROTATION OF TRIVALENT YTTERBIUM. Rubinstein, C. B.; Berger, S. B. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 36: 3951-2(Dec. 1965).

The Faraday rotation of Yb^{3+} in ytterbium aluminum garnet was studied. It was found that Yb^{3+} yields a positive paramagnetic contribution to the Faraday rotation caused by the $4f^{13}-4f^{12}5d$ transition. (D.C.W.)

8294 PARAMAGNETIC SPECIES IN GAMMA-IRRADIATED SINGLE CRYSTAL OF FERROELECTRIC LITHIUM TRI-HYDROGEN SELENITE, $LiH_3(SeO_3)_2$. Iwasaki, Hideo (Radio Research Labs., Tokyo). J. Phys. Soc. Jap., 20: 1783-9(Oct. 1965).

Gamma-irradiation of ferroelectric lithium tri-hydrogen selenite was shown to produce two kinds of paramagnetic species exhibiting the anomalous anisotropies of g-tensors at room temperature. These species show no hyperfine structure. Electron spin resonance spectra and optical absorption spectra suggest that the crystal contains ionic molecule $(SeO_3)^-$ as the paramagnetic species. This type of molecule was identified $^2A'$ as the ground state with symmetry of C_s. The anomalous anisotropies of g-tensors are explained by the admixture of excited states into the ground state. It is interpreted that the spectral lines corresponding to the two kinds of species are due to the existence of paramagnetic molecules $(SeO_3)^-$ which are reduced to $(SeO_3)_I^{2-}$ and $(SeO_3)_{II}^{2-}$ in the crystal lattice. The temperature dependence of g-tensors suggests that molecular structure of paramagnetic species varies somewhat at temperatures slightly below the melting point. (auth)

8295 IRRADIATION-INDUCED BROADENING OF THE F-ABSORPTION BAND IN KCl. Mizuno, Hiroyuki; Fowler, W. Beall (Univ. of Illinois, Urbana). J. Phys. Soc. Jap., 20: 1888-94(Oct. 1965). (COO-1198-213).

Earlier workers observed that in the initial stages of room-temperature F-band irradiation of additively-colored, freshly-quenched alkali halide crystals a low energy broadening of the F band appeared. Here this broadening in KCl was measured and similar results for two very different sodium concentrations were obtained. This indicates that sodium F_A centers are not responsible for the effect. The "resonance broadening" due to the dipolar interaction of two F centers was calculated. It was found that this mechanism could account for the observed phenomenon if most of the F centers were about 3 nearest neighbors apart, or if 5% of them were about 2 nearest neighbors apart. Published experimental results indicate that in the early stages of irradiation few of the F centers are this close together, although a number of small as 5% is not necessarily ruled out. Other possible explanations of the experimental results are discussed. (auth)

8296 MOESSBAUER EXPERIMENTS ON THE $FeSn_2$ ALLOY. Fabri, G.; Germagnoli, E.; Musci, M.; Locati, G. C. (Laboratori Centro Informazioni Studi Esperienze, Milan). Nuovo Cimento (10), 40B: 178-83(Nov. 11, 1965).

The antiferromagnetic $FeSn_2$ alloy, whose Néel temperature turned out to be 120°C, was studied with the help of Mössbauer experiments performed both with 14.4-kev γ rays from ^{57}Co and with 23.8-kev γ rays from ^{119m}Sn. Magnetic inductions were measured for both components and found equal to 150 kG at the iron nuclei and about 30 kG at the tin nuclei. A discussion is given of the observed isomeric shifts and quadrupole splitting. (auth)

8297 DEBYE-WALLER FACTOR OF ^{129}I IN $Na^{129}I$. Jaswal, S. S. (Univ. of Pennsylvania, Philadelphia). Phys. Lett., 19: 369-70(Nov. 15, 1965).

The Debye-Waller factor of ^{129}I in $Na^{129}I$ was computed using the deformation dipole model. In this model account is taken of the nearest neighbor short range interactions, the long range Coulomb forces, polarizability of the ions and deformation of the ions due to short range forces. The good agreement of the lattice dynamics calculations based on this model with the results of neutron scattering experiments shows that the model is quite realistic. A curve is given showing the recoilless fraction in the Mössbauer effect versus the temperature of iodine-129 in $Na^{129}I$. (J.F.P.)

8298 ELECTRON SPIN RELAXATION AND THE MOESSBAUER EFFECT IN FERRIC AMMONIUM SULPHATE. Boyle, A. J. F.; Gabriel, J. R. (Argonne National Lab., Ill.). Phys. Lett., 19: 451-2(Dec. 1, 1965).

An attempt is made to account for the previously obtained experimental results for the Mössbauer spectra for $Fe(NH_4)(SO_4)_2 \cdot 12H_2O$ at low temperatures in strong magnetic fields, obtained by Obenshain et al. (Phys. Rev. Letters 14, 365 (1965)). In ferric ammonium sulfate, the exchange and dipole-dipole hamiltonian couples the neighboring electron to the unpaired electron spin on the Mössbauer atom, causing the observed displacements of the gamma ray frequency. Although the matrix elements of this hamiltonian are temperature independent, the resulting modulation frequencies are not since they depend also on the Boltzmann factors for the electronic Zeeman splitting. The calculated complete absorption spectra are shown. (J.F.P.)

8299 EXISTENCE OF A MAGNETIC TRANSITION IN URANIUM SESQUICARBIDE U_2C_3. De Novion, C.; Costa, P.; Dean, G. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Phys. Lett., 19: 455-6(Dec. 1, 1965). (In French).

The magnetic susceptibility of U_2C_3 was measured. A strong change in the slope of the resistivity and in the thermoelectric power was found in the neighborhood of 50°K. This seemed to indicate a magnetic order-disorder transformation. In fact the experimental results proved that U_2C_3 does have a magnetic transition in the vicinity of 60°K. A remaining problem is pointed out: If the variation in entropy, accompanying this transformation is weak, what is the nature of this magnetism? It is suggested that there is a probable similarity to the mononitride UN, whose moments are known. The resistivity and thermoelectric power as well as the magnetic susceptibility of U_2C_3 are shown. (J.F.P.)

8300 ELECTRON SPIN RESONANCE OF CONDUCTION ELECTRONS IN BERYLLIUM. Cousins, J. E.; Dupree, R. (Univ. of Exeter, Eng.). Phys. Lett., 19: 464-5(Dec. 1, 1965).

The observation of a temperature dependent electron spin relaxation time in beryllium is reported. Measurements of linewidth were made using a conventional X-band spectrometer on a variety of samples from various sources. It is clear from the work that the impurities giving rise to transport scattering do not appear to be the same as those responsible for the scattering of the spins. Samples with the highest resistivity ratio do not necessarily have the narrowest linewidth. Conversion from the measured linewidth to relaxation time was made using Dyson's theory of lineshape. The results show that conductivity and relaxation time change at different rates; thus the conversion factor is a function of temperature. The variation of relaxation time is shown as a function of temperature. Measurements were also made of g values at room temperature. An anisotropy was found for g (with the magnetic field perpendicular to the c axis) to g (for a parallel field) of $5.0 \pm 3\ (10)^{-4}$. (J.F.P.)

8301 EFFECTS OF UNIAXIAL STRESS AND ELECTRIC FIELDS ON LOCALIZED VIBRATIONAL MODES. Hayes, W.; Macdonald, H. F.; Elliott, R. J. (Oxford Univ.). Phys. Rev. Lett., 15: 961-3(Dec. 20, 1965).

The effects of uniaxial compressional stress and high electric fields on the localized vibrational lines of H^- and D^- ions in CaF_2 were investigated in order to obtain more information about the interaction of the light impurities with the host lattice. These experiments are possible because of the narrow linewidths (about 1 cm^{-1}) at low temperatures. The stiffness constants were measured for CaF_2 over a wide range of impurities. An approximation in the analysis of experimental results is made that these apply to the vibrations of the light impurities. The energy levels and wave functions of the $\nu = 1$ levels of H^- ions in CaF_2 under uniaxial compressional stress or an electric field are given. The polarization of light absorption from the ground state is included. Splitting of the fundamental vibrational line of H^- in CaF_2 at 20°K is also shown. Many of the measurements for H^- ions were repeated for D^- ions, and, in agreement with calculations, the experimen-

tal splittings obtained for D^- are smaller than those for H^- by a factor of about $\sqrt{2}$. (J.F.P.)

8302 MEASUREMENTS OF RECOMBINATION EMISSION RELAXATION TIME OF $\approx 10^{-9}$ SEC FROM A SEMICONDUCTOR SOURCE. Zborovskii, A. A.; Skomorovskii, Yu. A.; Sushkov, V. P. Prib. Tekh. Eksp., No. 5, 224-7 (Sept.-Oct. 1965). (In Russian).

The theoretical characteristics are given and the installation and method are described for the measurement of the relaxation time of recombination $\sim 10^{-9}$ sec by means of the determination of the displacement phase between radiations and the current across the semiconductor source of the recombination radiation. The possibility of the use of the method for the determination of the lifetime of ground levels of nuclei in semiconductors is shown. (tr-auth)

8303 A MEASUREMENT BY NEUTRON SCATTERING OF MAGNETIC MOMENTS IN A PARAMAGNETIC IRON-NICKEL ALLOY. Collins, M. F. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Phys. Soc., 86: 973-6(Nov. 1965).

Paramagnetic neutron scattering was observed from an alloy of 65% Fe–35% Ni at temperatures up to about twice the Curie temperature and for energy transfers up to about 0.1 ev. The apparent iron atom moment is $1.4 \pm 0.3\ \mu_B$ and is not sharply temperature dependent whilst the moment in the ferromagnetic state is $2.3 \pm 0.25\ \mu_B$. The existence of so much paramagnetic scattering at such small energy transfers indicates that atomic moments in the paramagnetic phase are defined for a relatively long period of time. This is presumably due to correlation effects between electrons. (auth)

8304 INTERPRETATION OF MOESSBAUER SPECTRA OF PARAMAGNETIC MATERIALS IN A MAGNETIC FIELD. van der Woude, F.; Dekker, A. J. (Univ. of Groningen, Netherlands). Solid State Commun., 3: 319-21(Oct. 1965).

A formula is discussed for the hfs of Mössbauer spectra applicable also to situations in which the magnetic field at the nucleus fluctuates with a frequency comparable to the nuclear precession frequency. This formula can explain, e.g., the essential features of recent experimental data on hydrated ferric ammonium sulfate in a strong magnetic field at low temperatures. (auth)

8305 EXPERIMENTAL DEMONSTRATION OF THE s-d EXCHANGE INTERACTION IN f.c.c. COBALT BY SPIN WAVE SCATTERING OF POLARIZED NEUTRONS. Furrer, A.; Schneider, T.; Haelg, W. (Institut fuer Nukleartechnik, Zurich). Solid State Commun., 3: 339-41 (Oct. 1965). (In German).

The dispersion of the spin-waves in f.c.c. cobalt was investigated with polarized thermal neutrons. The Zener model of ferromagnetism is used for the interpretation of the anomalies occurring in the measurements, which is on an s-d interaction and was treated mathematically by Rudermann, Kittel, Kasuya and Yosida. The exchange integral exhibited logarithmic singularities for $|\vec{g} + \vec{\tau}_{hk}| = 2k_F$, which can be explained by means of a simple geometrical construction. (tr-auth)

8306 EFFECT OF A TWO-LEVEL IMPURITY SYSTEM ON THE PHONON SPECTRUM OF A CRYSTAL AND ON ONE-QUANTUM INELASTIC NEUTRON SCATTERING. Iolin, E. M. (Inst. of Physics, Academy of Sciences, Riga). Soviet Phys.-Solid State (Engl. Transl.), 7: 1198-1201(Nov. 1965).

Translated from Fiz. Tverd. Tela, 7: 1490-4(May 1965).

It is shown that two-level defects in small concentration have an appreciable effect near the resonance frequency on the phonon spectrum of a crystal, and on the form of the nuclear one-phonon coherent neutron scattering line in the crystal. (auth)

8307 INFRARED SPECTRA OF AMMONIUM AND THALLIUM(I) PERTECHNETATES. Mueller, Achim; Krebs, Bernt (Univ., Goettingen, Ger.). Z. Naturforsch., 20a: 967-8(July 1965). (In German).

The infrared spectra of crystalline NH_4TcO_4 and $TlTcO_4$ were measured in the range from 4000 and 300 cm^{-1}. The absorption maxima observed are tabulated. Correlations were made between the irreducible representations of the point groups T_d, S_4, and C_{5v}. The reasons for the difficulty of the assignments of the observed absorption bands of NH_4TcO_4 and $TlTcO_4$ in the range of the TcO deformation oscillations are considered. Other assignments are discussed. (J.S.R.)

8308 THEORY OF MULTIPOLE RELAXATION. II. MOTION EQUATIONS FOR ARBITRARY SPIN. Schwegler, H. (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 189: 163-75(1966). (In German).

A complete macroscopic description (generalized Bloch equations) of multipole resonance and relaxation in terms of multipolarizations, which are the expectation values of normalized multipole operators, is developed. These operators are constructed with the help of the Wigner-Eckart theorem. Using a relation for their commutators the reversible part of the generalized Bloch equations is derived, the structure of which depends on the spin quantum number I. (auth)

8309 THEORY OF MULTIPOLE RELAXATION. III. TREATMENT OF EXPERIMENTS IN PURE QUADRUPOLE RESONANCE. Schwegler, H. (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 189: 176-90(1966). (In German).

Using the generalized Bloch equations transient and steady-state experiments in pure quadrupole resonance of spin 1 and spin $\frac{3}{2}$ systems are discussed. A method of time averaging is employed to replace the use of auxiliary circular fields. The free induction signal after a short pulse of the radio frequency field as well as the quadrupole echo amplitude after a sequence of two pulses is calculated. For the case of a steady-state r-f field the complex susceptibility in terms of relaxation coefficients is given. (auth)

8310 COLLECTIVE EXCITATIONS IN SEMI-METALS. Kozlov, A. N.; Maksimov, L. A. Zh. Eksp. Teor. Fiz., 49: 1284-92(Oct. 1965). (In Russian).

Collective excitations in a double band electron system with Coulomb interaction are investigated in the presence of bound electron-hole pairs. The case of intersecting bands which formally is similar to the case of superconductivity is considered. A sound branch which is not inhibited, as in a superconductor, by plasma oscillations but exists simultaneously with the plasma branch is obtained by taking into account only the Coulomb interaction matrix elements (which are of the nature of $|k|^{-2}$ for small values of the transferred momentum k). If short range exchange matrix elements are taken into account, a gap appears in the sound branch. For $k = 0$ the energy of excitations with nonvanishing moments is found to be close to 2Δ with respect to the square of the coupling constant. (auth)

8311 POLARIZATION OF NUCLEI IN SEMICONDUCTORS AND SEMIMETALS BY A DIRECT CURRENT. Zvezdin, A. K. Zh. Eksp. Teor. Fiz., 49: 1313-25(Oct. 1965). (In Russian).

The effect of an electric current in a semiconductor or semimetal on the magnetization of the electron and nuclear spin subsystems is studied. Two mechanisms of interaction between the conductivity electron spins and lattice are considered, viz., interaction with acoustic and with optical phonons. The relaxation time of the conductivity electron spins is calculated for equilibrium and for hot electrons interacting with optical phonons. It is shown that interaction with optical phonons may be the main mechanism responsible for nuclear and electron polarization. (auth)

8312 STUDIES OF CONDUCTIVITY QUENCHING IN CdS CRYSTALS FOR PRIMARY EXCITATION WITH X RAYS [Thesis]. Thiel, H. Halle-Wittenberg, Ger., Univ., 1964. 80p. $2.00 Gmelin, AED-DISS. 64-733.

Infrared conductivity quenching of undoped CdS crystals with primary x-ray excitation is studied. Results are explained by a model with 2 types of recombination centers with different capture cross sections. (Gmelin Inst.)

REACTOR TECHNOLOGY

General

Refer also to abstract 7217.

8313 (CONF-651101-44) THEORETICAL INVESTIGATIONS OF FISSION PRODUCT DEPOSITION FROM FLOWING GAS STREAMS. Venerus, Ernest R.; Ozisik, M. Necati (North Carolina State of the Univ. of North Carolina, Raleigh). [1965]. Contract W-31-109-eng-52. 26p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From 13th Conference on Remote Systems Technology, Washington, D. C.

Suitable models that would govern the distribution of fission products in a coolant stream and the deposition of fission products on the surfaces of a conduit are discussed. Solutions of the transport and resistance models are given. It was concluded that the transport model provides a useful means of obtaining the adsorption energies of various isotope-surface material combinations. (P.C.H.)

8314 (GA-5316) WAMPUM—A GENERAL FUEL ECONOMICS CODE. Todt, F. W.; Triplett, J. R. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Oct. 27, 1965. Contract AT (04-3)-167. 55p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

WAMPUM is written in FORTRAN IV, and is in use on an IBM 7044 using the IBM 7040/7044 Operating System. WAMPUM is designed to provide a measure of performance for comparing or optimizing fuel cycles and associated reactor-core and fuel-element characteristics. The code takes into account: government and private fuel ownership; the distinction between "fed" and bred fuel; capitalization costs, by both explicit and implicit calculations; two fuel-particle species, and thus fuel-segregation effects; fuel costs in batch processing; and effects of ore costs and ore-separation costs on uranium costs. (T.F.H.)

8315 (IDO-17096) MACABRE. Griebenow, M. L.; Dickey, K. R. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Nov. 1965. Contract AT(10-1)-205. 54p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

MACABRE is a series of codes for the IBM 7040 computer; it is capable of solving the isothermal hydraulics and the nonisothermal hydraulics and heat transfer characteristics of most plate-type reactor fuel elements cooled by pressurized water in forced convection. MACABRE is employed in ATR and EOCR fuel element analyses. (auth)

8316 (NAA-SR-11450, Sect.7) REACTOR TECHNOLOGY SAFETY AND RESEARCH. (Atomics International, Canoga Park, Calif.). 158p.

Research on several areas of reactor technology is presented. Separate discussions are given for fission effects in metal fuels, synthesis, structure, and behavior of metal–hydrogen systems, age measurements, extrapolation length measurements, cross section analysis and applications project, fast spectrum Doppler measurements, structure, properties, and fission effects in UC and other refractory metals, interstitial fuels, study of BeO as a reactor material, continuous neutron flux monitor, multicycle reprocessing, reactor housing installations, fission product retention by reactor coolants, measurement of Doppler coefficients, atmospheric decontamination in reactor accidents, high-temperature chemistry, radiation chemistry, electronics structure of metals and alloys, and radiation damage in crystalline solids. (M.O.W.)

8317 NUCLEAR ENERGY INSTALLATIONS AND NUCLEAR RADIATION MEASUREMENT TECHNIQUE. Schruefer, Elmar; Stumpf, Willy (Allgemeine Elektricitaets-Gesellschaft, Frankfurt a. M.). Elektrotech. Z. B., 17: 473-6(1965). (In German).

A survey is presented of reactor installations that have been built or are being built in the Federal Republic, United States and the United Kingdom, based on the displays at the 1965 Hanover Trade Fair. The fuel-processing cycle in the U. K. and various radiation detection instruments were also displayed. (TCO)

8318 PROCEEDINGS OF THE REVIEW COURSE OF THE AVCP ON REACTOR PHYSICS. Vibers, G. V. (Univ., Lausanne, Switzerland). Neue Tech., 7: 179-83(Aug. 1965). (In French).

The seventh review course of the AVCP on reactor physics is briefly summarized. The topics discussed include neutron thermalization and its applications in calculations of reactor physics, various methods for the calculation of reactors and their application, and heterogeneous calculation of thermal reactors. (J.S.R.)

8319 SOME THERMODYNAMICAL PROBLEMS OF THE MOSEL REACTOR CONCEPT. Gat, Uri; Vornhusen, H. (Kernforschungsanlage, Juelich, Ger.). Nucl. Struct. Eng., 2: 355-9(Oct. 1965).

The MOSEL reactor concept concerns a fluid molten-salt reactor, in which operating conditions are influenced by salt freezing and boiling temperatures. The influence of temperature limitations on heat flux and power density is shown, and the importance of the thermal conductivity of the melt is illustrated. A generalized diagram is developed relating various combinations of power densities and heat fluxes as a function of unit cell dimensions and flow conditions of the fuel stream. The temperature rise of the coolant through the core is shown to be a function of core size, flow condition, and heat flux. (auth)

8320 HYDRAULIC INSTABILITY OF BOILING WATER REACTOR. Terano, Toshiro; Kurosu, Kenji (Transport. Tech. Res. Inst., Japan). Rep. Transport. Tech. Res. Inst. (Tokyo), No. 59, 1-17(Mar. 1963).

Two problems on oscillation are considered for the design of a stable boiling water reactor without driving any control rods. The first is physical oscillation depending on feedback action of the void coefficient, and the second is a hydraulic one generated to the kinetic behavior of the circulation water. Experiments on natural circulation, static characteristics and kinetics were performed using an electrically heated natural circulation test loop, and were analyzed by simple feedback theory. From experimental and computing results, the phenomenon of hydraulic instability could be explained by the nonlinear feedback theory. Besides, the oscillation of the two-phase flow itself or the effect of upper reactor which are thought to be other causes were considered. These effects were found to be negligible. The effect of pressure is estimated from calculation. (NSA of Japan)

Auxiliaries and Components

Refer also to abstracts 7341 and 8282.

8321 (AERE-R-5087) ESTIMATE OF THE PROBABILITY OF CAPTURE OF A SPECIES IN THE GAS IN A GRAPHITE PORE AS A FUNCTION OF THE CAPTURE PROBABILITY PER COLLISION AND THE ALBEDO AT THE PORE SURFACE. Tait, J. H. (Atomic Energy Research Establishment, Harwell (England)). Nov. 1965. 14p. Dep.

The probability of capture of a species, e.g., an oxygen atom in the gas of a pore in the graphite moderator of a reactor is calculated. For most cases it would seem that the probability of capture for one traverse of the pore is small. (auth)

8322 (APDA-179) CONCEPTS FOR GENERAL-PURPOSE UNDER SODIUM SCANNING SYSTEMS. Ying, Shuh-Pan; Scott, Clyde C. (Atomic Power Development Associates, Inc., Detroit, Mich.). Nov. 8, 1965. Con-

tract AT(11-1)-865. 47p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The development of the concepts for general-purpose scanning systems is discussed, based on the consideration of ultrasonics operating in liquid sodium. Technical information and data, such as ultrasonic attenuation in liquid sodium, piezoelectric materials operating in 600 F sodium, etc., are provided from theoretical and experimental studies. Also included are the explanations, analyses, and applications of the single-narrow-beam scanning systems and the electronic acoustic image conversion methods. (auth)

8323 (CONF-651032-1) ANALYSIS OF VIBRATION CHARACTERISTICS OF A SINGLE-BLADED CONTROL ROD PIVOTED AT ITS DOWNSTREAM END. Miller, D. R. (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 30, 1965. Contract W-31-109-eng-52. 57p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

From Flow Instability Conference, Schenectady, N. Y.

A theoretical analysis was made to determine the conditions under which a single-bladed control rod pivoted at its downstream end will experience a sustained coolant-flow-induced vibration. Two solutions were obtained. One employed an integration of pressure drops and torques from the upstream end of the blade to the downstream end and gave expressions for the flow rate below which vibrations die out and the vibration frequency at that rate. The other solution employed integration in the opposite direction, let the flow rate be an independent variable, and gave expressions for the vibration frequency and the magnitude and algebraic sign of the external damping coefficient of a viscous damper which would enable the system to sustain small-amplitude vibrations at constant intensity. Two separate abstracts were prepared for two other included papers on the analysis of translating rod in channel and flow-induced vibration of reactor control rods. (M.O.W.)

For abstracts of individual papers see: 8324 and 8325.

8324 (CONF-651032-1, Paper 1) ANALYSIS OF TRANSLATING ROD IN CHANNEL. Kennison, R. G. (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 26, 1965. 15p.

A theoretical analysis was made to determine the conditions under which a single-blade reactor control rod will experience coolant flow-induced vibrations. It is assumed that no flow goes through the blade or around the blade edges and that no forces are generated by relative movement of the blade edges and the edge of the walls of the channel. Results for certain conditions are presented. (M.O.W.)

8325 (CONF-651032-1, Paper 2) FLOW-INDUCED VIBRATION OF REACTOR CONTROL RODS. Kennison, R. G.; Miller, D. R. (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 30, 1965. 16p.

Supplementary work for the previous papers on flow-induced vibration of reactor control rods is presented. Brief discussions on the hydraulic spring force on the blades, general characteristics of a vibrating blade, and the zero frequency solutions are presented. Some calculations are also included. (M.O.W.)

8326 (COO-1213-27) STRAIN GAGE TEST REPORT ON 30 MEGAWATT STEAM GENERATOR PROTOTYPE FOR SODIUM COOLED REACTOR SYSTEMS. (Baldwin-Lima-Hamilton Corp., Philadelphia, Pa. Industrial Equipment Div.). Dec. 1, 1964. Contract AT(11-1)-1213. 159p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

A description of strain gages used, individual strain gage location on the steam generator, methods of attaching strain gages to the vessel, methods of attaching strain gages to the vessel, and methods of water-proofing strain gages, and methods of recording strains are reported. Results of strain gage tests where actual experimental strains were recorded, strains converted to stresses, and actual stresses compared to theoretical stresses recorded in the design report are included. Data are tabulated. (P.C.H.)

8327 (EURAEC-1487) HEAT TRANSFER AND FLUID FLOW CHARACTERISTICS IN A PRESSURIZED WATER REACTOR. Quarterly Progress Report No. 5, January 1–April 1, 1965. (Technische Hogeschool, Eindhoven (Netherlands)). Sept. 1965. Contract 011-64-1 Teen(RD). 20p. (EUR-2654; WW-015-R87). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The first experiments were started in the 140-atm pressurized water loop. These experiments are the first of an introductory program on mixing. The influence of a cold wall and of mixing between the fuel channel and a surrounding channel on the burnout power will be measured. A proposal is being made for other test sections for establishing the mixing effects between subchannels in a more fundamental way by making mass and heat balances in separate channels. The theoretical study on the hydraulic coupling of parallel channels is being continued. The study was divided in one part without introducing interaction effects and a second one where transverse transport of fluid and vapor across the boundaries of the individual channels caused by diffusion and by differences in pressure is present. The equations for both cases were derived. (auth)

8328 (LA-3240) AN EXPERIMENTAL DC ELECTROMAGNETIC PUMP FOR A MOLTEN PLUTONIUM ALLOY. Caldwell, Gary L. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Aug. 1, 1965. Contract W-7405-eng-36. 37p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A d-c electromagnetic pump was used to pump a molten plutonium-cobalt-cerium alloy in a small isothermal closed loop made of tantalum. The purpose of the experiment was to determine operational characteristics of such a pump and an electromagnetic flowmeter in the same loop. Developed pump head was determined by observing radiographically the fluid levels in manometer pressure taps on the inlet and outlet of the pump section. Two models of the system were constructed to study operational characteristics of an electromagnetic pump and flowmeter when used with a fluid of relatively high electrical resistivity and density. In these models mercury was the pumped fluid, and copper and tantalum were the containment materials. Operation of the pump with the molten plutonium alloy was very successful, and the results were within expectations. (auth)

8329 (NAA-SR-Memo-11423) LARGE SGR PROCESS TUBE AXIAL BUCKLING TEST APPARATUS. Dudley, M. (Atomics International, Canoga Park, Calif.). June 8, 1965. Contract AT(11-1)-Gen-8. 8p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A test apparatus is described that was designed and built to permit a study of the axial buckling characteristics of the LSGR full-length process tubes under simulated pressure, boundary, and reactor temperature conditions with bellows attached at the lower end. (M.O.W.)

8330 (NP-15689) PHOTOVOLTAIC MONITOR. Progress Report, December 15, 1964–June 30, 1965. Softky, S. D. (Stanford Research Inst., Menlo Park, Calif.). July 1, 1965. Contract 298/RB. 4p.

Progress toward the development of a passive, integrating, reactor power monitor which is based upon a radiation-powered bulk photovoltaic cell is reported. This cell consists of a layer of Ta_2O_5 anodized upon a Ta substrate with an Au counter electrode evaporated on the insulating layer. (M.O.W.)

8331 (WCAP-3269-45) REACTOR CONTROL AND PROTECTION SYSTEMS FUNCTIONAL REQUIREMENTS AND PERFORMANCE. King, W. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Mar. 1965. Contract AT(30-1)-3269. 114p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The results of the development of control and protection systems for a 395 Mw(e) closed-cycle water reactor with chemical shim control are presented. The additional re-

quirements and limitations for operation at 450 Mw(e) stretched power are also included. The functional requirements and performance of reactor control and protection systems are discussed in detail. The results of parametric studies to demonstrate the sensitivity of operating margins as a function of design parameters are summarized. In the control system study, emphasis is placed on the reactor plant transient responses to various specified plant disturbances such as ±10% step load changes, 50% step load rejection, loading and unloading, turbine trip and scram, and electrical system frequency dip. In the protection system study, emphasis is placed on the protection analysis for various postulated accidents including: reactivity insertion, steam break, loss of load, and loss of flow. (auth)

8332 CONTROL AND INSTRUMENTATION OF NUCLEAR REACTORS. Merz, L.; Jaschek, H. Technische Hochschule, Munich). Kerntechnik, 7: 429-32(Oct. 1965). (In German).

A general survey is given on measurements and control at nuclear reactors. Problems of safety instrumentation are also considered. (auth)

8333 INSTRUMENTATION OF THE POWER CHANNEL OF REACTORS. Nottelmann, W. (Allgemeine Elektricitaets-Gesellschaft, Heiligenhaus, Ger.). Kerntechnik, 7: 458-60(Oct. 1965). (In German).

The determination of the thermal power of a reactor may be reduced to the measurement of neutron flux density which is proportional to the number of fission events and, therefore, to the energy released in this process. D-c amplifiers with neutron sensitive ionization chambers to be used as sensitive elements make up the power measuring channels necessary for the reactor process: linear measuring channel with range switching, logarithmic measuring channel with measurements of period. The amplifiers for the different channels are composed of few connected units produced by means of printed circuits. Only semiconductors are used and the required different correlations between output voltage and input current can be obtained only by a special layout of the negative feedback circuit. (auth)

8334 INSTRUMENTATION OF THE START-UP CHANNEL OF REACTORS. Leiter, E. (Allgemeine Elektricitaets-Gesellschaft, Munich). Kerntechnik, 7: 461-3(Oct. 1965). (In German).

A description is given on measuring methods and instrumentation at the startup channel of reactors. Operation and performance of the detectors and the various construction units are illustrated. The logarithmic measuring range extends from 1 to 10^5 counts/s. As construction units printed cards are used. The circuits are exclusively equipped with semiconductors. The AEG semiconductor reactor instrumentation is manufactured in $\frac{1}{3} \cdot 19''$ plug-in units. (auth)

8335 JET PUMPS ADVANCE BWR RECIRCULATION FLOW-DESIGN. Gluntz, Douglas M.; Moen, Robert H.; Wray, John L. (General Electric Co., San Jose, Calif.). Nucleonics, 23: No. 12, 58-61(Dec. 1965).

The development of advanced recirculation systems incorporating high-performance jet pumps for boiling water reactors is discussed. A brief description is given of the system for the Dresden II plant. (L.B.S.)

8336 POWER SUPPLY PLANT FOR THERMAL TEST STANDS IN THE NUCLEAR RESEARCH STATION AT JUELICH IN NORTH RHINE-WESTPHALIA. Neumann, Manfred; Vieten, Manfred (Kernforschungsanlage des Landes, Juelich, Ger.). Siemens Rev., 32: 175-80(May 1965).

In investigations on the heat transfer conditions in fuel elements and heat exchangers, as part of a comprehensive program, model tests are being carried out on large test stands under simulated reactor operating conditions, using heat produced electrically instead of by nuclear fission. The electric power required to operate the large thermal test stands is supplied by a power supply plant with a total installed capacity of 3150 kv. In the second stage of construction the plant capacity will be doubled. The four large test stands which are supplied with electric power for heat and power drives are described. They include: (1) a low-pressure gas tunnel that serves for thermal tests on tube bundles and other reactor components in an air stream at atmospheric pressure and temperatures up to 250°C. (2) a high-pressure gas tunnel, used for thermal tests on tube bundles and other reactor components in a gas stream at pressures up to 40 kg/cm² and at gas temperatures up to 400°C. (3) a high-pressure gas circuit which serves for thermal investigations on fuel elements for gas-cooled reactors at pressures up to 80 kg/cm² and gas temperatures up to 500°C. (4) a pressurized-water and boiling-water circuit, now in the planning stage, which will serve for thermal investigations on fuel elements for pressurized-water and boiling-water reactors at pressures up to 250 kg/cm² and water temperatures up to 400°C. Specifications and operation of the above-mentioned components are described in detail. (BBB)

8337 TEMPERATURE DEPENDENCE OF THE THERMAL NEUTRON PROPERTIES OF HEAVY WATER [Thesis]. Daughtry, James William. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1965. 86p.

The thermal neutron properties of heavy water were measured over a temperature range of 25° to 250°C by the pulsed neutron method. The measurements were made on 99.69 ± 0.02 mole percent D_2O. A 1.0-Mev Van de Graaff provided the neutrons by means of a pulsed deuteron beam and a beryllium target. The decay constants for the thermal neutron population in cylindrical D_2O geometries were obtained with a 26-channel time analyzer over a range of bucklings from 0.025 cm^{-2} to 0.060 cm^{-2}. The temperature was varied from 25° to 250°C in 25-degree increments. Values of D_0 and C were obtained at each temperature by a least squares fit of the data to the expression $\gamma = \gamma_0 + D_0B^2 - CB^4$. The infinite medium decay constant, γ_0, was calculated at each temperature from known density and cross-sectional data. An iterative process was used to make the value of D_0 used in the expression for the extrapolation distance ($d = 2.1312\ D_0/\overline{\nu}$) consistent with the results of the least squares fit. The values obtained for D_0 were corrected for H_2O contamination and were compared with published theoretical and experimental results. Preliminary measurements were made to determine the time required for the neutrons produced by the $Be^9(d,n)B^{10}$ reaction to reach thermal equilibrium in the D_2O. Two methods were used for these measurements, the two-detector ratio method and the boron absorber method. The results showed that about 200 μsec were sufficient for the equilibrium neutron energy distribution to be established. The high-temperature measurements necessitated the design and fabrication of a pressure vessel and the associated pressure and temperature control systems. Computer programs were developed for use in the analysis of pulsed neutron data. (Dissertation Abstr.)

8338 NUCLEAR POWER PLANT IN WHICH VAPOUR IS USED FOR COOLING AN ATOMIC REACTOR. Imbert, Roger Jean; Chaboseau, Jacques Pierre (to Societe Rateau SA). German Patent 1,201,499. Sept. 23, 1965. Priority date July 21, 1961, France.

In the nuclear power plant the vapor used for cooling the nuclear reactor is divided, upon leaving the reactor, into two streams which flow through different circuits in the plant, in the first of which the vapor serves to generate power and in the second of which it serves to cool the reactor, the first circuit including a turbine, having a condenser associated therewith, and a pump for recycling condensed fluid and the second circuit including a vapor generator and means for recirculating the condensed liquid through the vapor generator, to be re-vaporized therein before being returned to the reactor. The low pressure stage of the turbine, the condenser, the vapor generator, a superheater disposed within the vessel of the vapor generator, and the high pressure stage of the turbine are connected in series in the first circuit. (Gmelin Inst.)

8339 DEVICE FOR CUTTING OFF A THERMOCOUPLE CABLE ATTACHED TO A NUCLEAR FUEL ELEMENT IN THE CORE OF A NUCLEAR REACTOR. Trussler, Geoffrey Arnold (to English Electric Co. Ltd.). German Patent 1,201,500. Sept. 23, 1965. Priority date Aug. 28, 1962, Great Britain.

The thermocouple cable has a looped portion which is straightened on pulling and pressed against a knife edge attached to the fuel element. (Gmelin Inst.)

8340 DEVICE FOR CHARGING AND DISCHARGING A LIQUID MODERATED NUCLEAR REACTOR. Rouge, Pierre (to Commissariat a l'Energie Atomique). German Patent 1,201,926. Sept. 30, 1965. Priority date Mar. 15, 1956, France.

The core is composed of a plurality of fuel drums rotable about the central axis of the drums which are made up of a plurality (4,5,7..) of parallelly disposed tubes in which there are the fuel elements and through which the reactor coolant is circulated. The drums extend throughout the length of the core and are held in place between a lower retaining and an upper retaining plate by means of a central hollow shaft which may also be charged with a fuel element. Charging and discharging is facilitated by rotating the individual drums about their central axis to bring one tube after another into an axial alignment with a channel provided in the wall of the reactor vessel. (Gmelin Inst.)

8341 DOUBLE-WALLED PRESSURE TUBE FOR A NUCLEAR REACTOR. Boiron, Pierre Georges (to Groupement Atomique Alsacienne Atlantique). German Patent 1,201,927. Sept. 30, 1965. Priority date July 30, 1962, France.

The double-walled pressure tube comprises an inner conduit for the reception of the working medium designed to withstand high pressure and an outer conduit spaced from the inner conduit which are joined at their ends by means of muffs provided with inlets and outlets for the circulation of a thermally insulating fluid through the annular space between the two conduits. Means are provided for fixing the tube in the wall of the reactor block and for connecting the inner pressure conduit tightly with the coolant circuit. (Gmelin Inst.)

8342 DRIVE ARRANGEMENT FOR NUCLEAR REACTOR CONTROL RODS. Thomas, Harold Albert; Clifford, Charles Edward (to General Dynamics Corp.). German Patent 1,202,405. Oct. 7, 1965. Priority date Aug. 9, 1960, United States.

The system for controlling a nuclear reactor having a prompt negative temperature coefficient consists of means for instantaneously withdrawing the rod to a predetermined position, additional means for withdrawing the rod at a predetermined rate, and means for stopping the rod when it is withdrawn from the reactor to a second predetermined position. The withdrawing system includes a support means, a cylinder carried by the support means, a piston movable within the cylinder and connected to the control rod, means connected to the cylinder for moving the cylinder relative to the support means, a source of fluid pressure, and means for connecting the source of fluid pressure to the cylinder. (Gmelin Inst.)

Criticality Studies

Refer also to abstracts 7501, 8038, 8045, and 8395.

8343 (ANL–7023) THE ARGONNE-REVISED THERMOS CODE. Toppel, B. J.; Baksys, I. (Argonne National Lab., Ill.). Mar. 1965. Contract W-31-109-eng-38. 112p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The THERMOS code computes the scalar thermal-neutron spectrum as a function of position in a lattice by solving the integral transport equation with isotropic scattering. One-dimensional slab or cylindrical geometry can be used. The revised codes described are written entirely in 3600 FORTRAN for the CDC-3600 computer. (M.O.W.)

8344 (ANL–7041) FREQUENCY-RESPONSE ANALYSIS OF STEAM VOIDS TO SINUSOIDAL POWER MODULATION IN A THIN-WALLED BOILING WATER COOLANT CHANNEL. St. Pierre, Carl C. (Argonne National Lab., Ill.). May 1965. Contract W-31-109-eng-38. 148p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

Experimental measurements of power-to-void transfer functions were made in a vertical, rectangular, electrically heated test section in which four main loop parameters were varied: pressure from 200 to 800 psia; inlet flow rates from 2.52 to 3.78 ft/sec; heat fluxes from 2.28×10^4 to 9.12×10^4 Btu/(hr)(ft^2) and inlet subcoolings from 0.8 to 12.4°F. Data were obtained at three axial positions and also at various transverse positions across the width of the channel for a fixed axial height. These data were compared to various theoretical models. (M.O.W.)

8345 (BAW–66) SPECTRAL SHIFT CONTROL OF PRESSURIZED WATER REACTORS. Edlund, M. C.; Rhode, G. K. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). [nd]. 12p.

The substitution of deuterium for hydrogen in the moderator of an internal converter of a PWR causes an appreciable shift in the neutron spectrum giving rise to many effects which change the effective multiplication constant. This technique was applied to a particular PWR. Various physics calculations and a discussion of results are presented. (M.O.W.)

8346 (EUR–2532.e) NEUTRON SPECTRA MEASUREMENT IN FAST REACTORS USING FOILS DETECTORS. PART I. THEORETICAL CONSIDERATIONS. Diercks, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Oct. 1965. 32p. Dep. mn.

The theory of a method for measuring neutron spectra in fast reactors by foil activation techniques, and a proposed experiment to test the method, are described. A theoretical simulation of the experiment, illustrated by five calculated examples, permits one to evaluate the usefulness of the method, and to estimate the errors due to the method. The integral of the spectrum can be found with a precision of a few percent depending on the spectrum measured. The differential spectrum obtained was found to be a mean of the real spectrum, from which the real spectrum showed slight local deviations. (auth)

8347 (GA–6612) RELOAD FEVER—A ONE-DIMENSIONAL FEW-GROUP DEPLETION PROGRAM FOR REACTOR FUEL CYCLE ANALYSIS. Todt, F. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Sept. 28, 1965. Contract AT(04-3)-167. 246p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

RELOAD FEVER combines and extends the methods used in FEVER, a one-dimensional depletion code, and GAD, a nondimensional code for fuel cycle analysis, to form a one-dimensional fuel cycle code. The result is a few-group depletion calculation which allows fuel in various stages of irradiation to be homogenized into the same region for purposes of the diffusion calculation, but follows the depletion of each of the subregions separately. Flux, power distribution, and K_{eff} are computed by means of a few-group diffusion routine limited to 100 mesh points and 4 energy groups. The program is written in FORTRAN IV for the IBM 7044. (M.O.W.)

8348 (JINR-P–2391) KORRELYATSIONNAYA TEORIYA NEITRONOV V YADERNYKH REAKTORAKH I KONTSEPTSIYA PEREDATOCHNOI FUNKTSII. (Correlation Theory of Neutrons in Nuclear Reactors and a Concept of Transfer Function). Kozik, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1965. 26p. Dep. mn.

Using the Green function of the Boltzmann equation and equations for binary densities of the central second order moments one can construct a theory of neutrons in nuclear reactors which is easily associated with a concept of transfer function. (auth)

8349 (RT/FI(65)14) SITUAZIONE ATTUALE DEI METODI DI CALCOLO DEI RETICOLI CONTENENTI PLUTONIO. (Current Position on Methods for Calculating Plutonium Lattices). Loizzo, P.; Tondinelli, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). July 1965. 13p. Dep. mn.

Six critical experiments in PuO_2 lattices performed at Hanford are calculated with different methods. (auth)

8350 (RT/FIMA(65)5) RAM—AN IBM-7094 MONTE CARLO CODE FOR CRITICALITY CALCULATIONS. Cupini, E.; De Matteis, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1965. 29p. Dep. mn.

RAM is an IBM-7094 Monte Carlo code suitable for multigroup criticality calculations for small fast assemblies. The main purpose of the code is to find K_{eff} and the energy-space distributions of neutrons in many-zoned spherical or cylindrical (r,z) geometries. The nuclear reactions considered are absorption, elastic and inelastic scattering, and fission. (auth)

8351 (WCAP-2685) MOCA 2A—A FAST EFFECT MONTE CARLO CODE FOR THE IBM 7090. Dannels, Robert A. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.); Honeck, Henry C. (Brookhaven National Lab., Upton, N. Y.). [nd]. 125p. Dep. mn.

MOCA 2A is a Monte Carlo digital computer code which, by simulating the actual behavior of neutrons, statistically determines most of the quantities of interest to the reactor physicist and analyst. Designed primarily for the fast energy range, the code obtains results (such as fast fission, absorption, flux, age, slowing down distribution, etc.) for a heterogeneous lattice. A detailed explanation of what quantities may be calculated, exactly how they are determined and their physical interpretation is given as well as instructions for using the code. (auth)

8352 CALCULATION OF THE NEUTRON RESONANCE ABSORPTION IN NUCLEAR REACTORS. Stefan, H. (Inst. of Atomic Physics, Bucharest). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 649-60(1965). (In Rumanian).

The calculation of the multiplication coefficient of a reactor is examined, starting from the concept of neutron resonance escape probability and taking into consideration the resonances of the (n,γ) absorption cross section of the fuel above the thermal neutron level. The problem is further developed on the basis of the energy dependence of the (n,γ) absorption cross section of ^{238}U which is similar to that of ^{232}Th. The region of resolved resonances, from 0 to 420 ev and the statistical region, beyond 420 ev were examined. The actual value of the cross sections is of great importance for designer of fast reactors. However, a recent survey of the American-European Nuclear Data Committee indicated that the required 0.25 to 0.5% accuracy is very difficult to achieve, even for thermal neutron cross sections. For this reason, zero-power experiments and other methods must be used whenever the critical configuration must be known with great accuracy. The narrow resonances and the narrow resonances infinite absorbers approximation methods were examined together with other suitable calculation methods. Some of the experimental methods, such as activation and reactivity measurements cause problems; the resonance integral measurement in reactor lattices yielded very good results. (Monographic study, 22 references). (TTT)

8353 CALCULATION OF FLUX DISTRIBUTION AND EIGENVALUE OF ARBITRARILY SHAPED REACTORS BY MEANS OF THE CALCULUS OF VARIATIONS. Unger, H. Atomkernenergie, 10: 413-14(Nov.-Dec. 1965). (In German).

An investigation was made on the effect of the reactor shape on the essential characteristics of the reactor, e.g., specific power and surface heat flux density. The problem consisted of calculating and comparing the neutron flux distribution and criticality of bare, homogeneous simple-bordered reactors of arbitrary shape in order to obtain the reactor form associated with the optimal reactor. A method is presented for the solution of the problem by means of a variational calculation. (L.B.S.)

8354 METHODS OF CALCULATION FOR COUPLED FAST-THERMAL SYSTEMS AND THEIR COMPARISON WITH EXPERIMENTAL RESULTS. Gebhardt, W. (Interatom, Bensberg, Ger.). Atomkernenergie, 10: 414-17 (Nov.-Dec. 1965). (In German).

For a thermal reactor with sodium cooling and a zirconium hydride moderated core the possibility was investigated of using such a system for coupled fast-thermal operation. The methods used in the respective calculations are presented as well as a comparative analysis to check methods and cross sections with a known theoretical and also a known experimental example. (auth)

8355 RESONANCE SELF SHIELDING IN FAST REACTORS. Pucker, N. (Univ., Graz, Ger.). Atomkernenergie, 10: 418(Nov.-Dec. 1965). (In German).

The resonance self shielding of fissile and fertile isotopes can be taken into account by the definition of appropriate "effective" cross sections. In this way it is possible to calculate temperature dependent group cross sections for every energy group interval and every weighting spectrum. (auth)

8356 A CONTRIBUTION TO THE PROBLEM OF RESONANCE ABSORPTION IN HETEROGENEOUS SYSTEMS. Henssen, H. (Interatom, Bensberg, Ger.). Atomkernenergie, 10: 419-20(Nov.-Dec. 1965). (In German).

An outline of a new method for calculating resonance integrals in heterogeneous systems is presented. Attention is focused on the slowing-down in substances of intermediate atomic weight in the non fuel region. Spatial dependence is treated regionwise by using collision probabilities P_{ij}. The slowing-down problem can be formulated by a system of coupled differential equations. (auth)

8357 CALCULATION OF CONTROL ROD WORTH AND COMPARISON WITH EXPERIMENTAL RESULTS OF THE CRITICAL FACILITY KNK. Ullrich, W.; Sauerland, T. (Interatom, Bensberg, Ger.). Atomkernenergie, 10: 421-3(Nov.-Dec. 1965). (In German).

The control rod worths of various absorber configurations, measured in core II of the Critical Facility KNK, are analyzed by calculational methods in use at Interatom. These methods incorporate spectral, transport, and diffusion codes. A comparison of the calculated and experimental rod worths shows agreement within 10 per cent, thus indicating the adequacy of the nuclear design methods used. (auth)

8358 OPTIMAL POWER DECREASE FOR MINIMIZING XENON POISONING. Sato, Kohei (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 29: 429-41(June 1965).

A method for finding the process for optimum decrease of reactor power in order to minimize xenon poisoning is reported. The xenon buildup is proved to be an explicit function of the final value of neutron flux density and of the concentrations of ^{135}I and ^{135}Xe. The final-value control problems are solved by the maximum principle. It is verified that the optimum control for minimizing xenon poisoning is bang-bang control, in which the reactor period or the reactor-power rate takes alternately its maximum and minimum allowed values. The optimum processes obtained are easy to carry out, for the numerical examples considered. (auth)

8359 AUTOMATIC PLOTTING OF ISOFLUX CONTOURS WITH ON LINE PRINTER. Nakamura, Shoichiro (Nuclear Reactor Design Section, Hitachi Ltd., Japan). J. Nucl. Sci. Technol. (Tokyo), 2: 422-4(Oct. 1965).

A mechanical contour plotting process incorporating an on-line printer directly reproducing the results of flux calculations is described. An example of a raw output from the computer using this method shows a plot of thermal flux contours. A diagram of the completed isoflux contours is shown in which the curves are marked

with flux level numbers and the actual arrangement of the core is drawn in. (L.B.S.)

8360 CALCULATION OF THE EFFICIENCY OF ROD-SHAPED HETEROGENEITIES IN HOMOGENEOUS REACTOR CORES AND COMPARISON WITH EXPERIMENTAL DATA. Heinrich, H. (VEB Atomkraftwerk, Berlin). Kernenergie, 8: 557-63(Sept. 1965). (In German).

A method of calculating the efficiency of rod-shaped heterogeneities in homogeneous reactor cores in the three-group diffusion approximation is described. Collision probabilities in highly absorbing regions of the rod were used. The method was proved by calculating experimental data. The role of flux "denting" due to the rods is discussed. The influences of some uncertainties in the calculation model were studied. A value for radial reflector saving was obtained from the efficiencies measured using a special technique of fitting. (auth)

8361 STABILITY EXTREMA IN NUCLEAR POWER SYSTEMS WITH DESIGN UNCERTAINTIES [Thesis]. Kerlin, Thomas Wesley Jr. Knoxville, Tenn., Univ. of Tennessee, 1965. 139p.

Practical analytical techniques that provide a sufficient condition for inherent reactor stability in spite of system parameter uncertainties were developed. The techniques involve the use of linear stability theory and mathematical programming techniques. The negativeness of the real part of the least negative eigenvalue of the system matrix is used as a coefficient of performance. The effect of changes in each of the system parameters on this coefficient is found, giving the components of the gradient of the coefficient of performance in system parameter space. Then the gradient projection method of nonlinear mathematical programming is used to systematically locate the least stable condition possible in the expected range of system parameters. The techniques are also suitable for handling the inverse problem, that of finding the combination of parameters in a specified range that gives the most stable condition. The techniques were used to solve several problems in order to demonstrate the validity and practicality of the methods. (A.G.W.)

8362 ENERGY AND SPATIALLY DEPENDENT IMPULSE RESPONSE AND TRANSFER FUNCTIONS OF NUCLEAR SYSTEMS [Thesis]. Kavipurapu, Sri Ram. Tallahassee, Florida State Univ., 1964. 185p.

In a theoretical and experimental study of the transfer and impulse response functions of nuclear systems the theoretical model is based on a two-group, multiregion hypothesis. The effects of delayed neutrons are included. A slab geometry, finite in one direction and infinite in the other two directions, is considered. The theoretical spatial and energy dependent transfer functions relate the thermal and fast neutron density fluctuations at some point $\bar{r}$ in the nuclear system to a time-varying artificial source at some other point $\bar{r}_0$, of either fast or thermal neutrons. The theoretical treatment brings out such salient points on the definition of the effective nuclear parameters and the independence of the dispersion relation from the number of regions under consideration. The impulse response function is obtained by the inverse Laplace transformation of the transfer function. Experiments performed on the University of Florida Training Reactor (UFTR) are described. The impulse response function is obtained by cross correlating the pseudo-random binary input neutron source with the neutron density variations using two detectors, located at two different points in the reactor. Transfer functions are calculated by obtaining the cross power spectra of the input neutron source and the neutron detector output. The experiments demonstrated the ability of the random noise techniques to obtain the shutdown margin, indirectly through the decay constant Rossi alpha, of either cold or hot reactor cores, without introducing any foreign materials into the system. Theoretical results are in good agreement with experimental measurements of the thermal transfer and impulse response functions, provided proper leakage of the finite system is included in the calculations. The experimental values for the time location of the peak of the impulse response function, at the center vertical port location for different reactivities, are in close agreement with theory. (A.G.W.)

8363 MEASUREMENT OF NUCLEAR REACTOR PARAMETERS THROUGH NEUTRON DETECTION PROBABILITIES [Thesis]. Bryce, Donald Hewitt. Ithaca, N. Y., Cornell Univ., 1965. 98p.

Theoretical models of detector counting rate variance-to-mean ratio and the Rossi-α experiment in a one-velocity point reactor are developed. These models include prompt and delayed neutron effects and are based upon the reactor impulse response rather than the reactivity transfer function. The theory of the Rossi-α experiment is presented in terms of a conditional neutron detection probability. When restricted to prompt neutron detections, the coefficient of the time-dependent term of the conditional detection probability is independent of reactivity. A simple relationship between detector counting rate and prompt neutron population decay constant (α) is employed to permit extrapolation of measured subcritical decay constants to delayed critical, thus determining the ratio of effective delayed neutron fraction to prompt neutron generation time. The Rossi-α experiment is also used for the determination of large subcritical reactivities. Results of the variance-to-mean model are employed as aids in the statistical analysis of experimental data. Results of experiments designed to test models are reported. This series of experiments was performed on two of the Cornell University Zero Power Reactor cores. Data analysis was performed on the Cornell University Control Data Corporation 1604 computer. The machine programs employed for counting rate sample space examination, least squares fit to exponential plus constant, and calculation of theoretical variance-to-mean ratio as a function of counting interval, reactivity, and neutron lifetime are presented in an appendix. The experimental program confirms the predictions of the theoretical models, indicating that, for the purposes of statistical analysis, the one-velocity point reactor model is adequate. (Dissertation Abstr.)

8364 THE CROSS CORRELATION OF THE NEUTRON DENSITY FLUCTUATIONS AT TWO POINTS IN A NUCLEAR REACTOR [Thesis]. Sheff, James Robert. Seattle, Univ. of Washington, 1965. 222p.

The theory of space-dependent stochastic fluctuations is developed in sufficient generality that any specilization can be made to a particular reactor model by finding the appropriate Green's function for the mean neutron density equation of the system in question. The approach used is the Langevin technique, which, as applied here, yields the cross correlation function as a double convolution over two Green's functions and the correlation function of equivalent "noise sources" present within the system. The character of these noise sources is examined in considerable detail. It is shown that when delayed neutron effects are included, the input noise sources are not white, i.e., their spectral density functions are not constant. A clear distinction is made between fluctuations in the neutron density and the fluctuations observed with a detector. The density fluctuations include contributions from a neutron correlated with itself and direct progeny whereas the mechanism of detection (invariably removing a neutron) eliminates this correlation. Through an investigation of the neutron density space-time Green's function and its related transfer function, a general procedure for greatly simplifying the inclusion of delayed neutron effects in the spectral density function is developed. The method developed is then applied to several cases designed to illustrate the effects of geometry upon the correlation and spectral density functions. One energy group diffusion theory is assumed throughout in order to avoid clouding the geometric effect with other effects. The general formalism is developed for treating problems having more than one region in one direction. The case of a three slab reactor is considered in some detail. (Dissertation Abstr.)

Design and Feasibility

8365 (RT/ING(65)10) DESIGN AND PERFORMANCE OF ORGANIC COOLED REACTORS. Basso, G.; Hebert, J. E.; Swanson, N. J. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sept. 1965. 71p. Dep. mn.

The physics, engineering, coolant technology, operations, safety and maintenance of existing and proposed organic reactor systems are reviewed and discussed. Technical and economic comparisons are made between organic and water type systems. Perspectives associated with the potentials in the possible family of competitively functioning organic reactor systems are surveyed. (auth)

8366 FROM THE KAHL VAK TO THE GUNDREMMINGEN KRB. Weckesser, A. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Ger.). Atomwirtschaft, 10: 565-7(Nov. 1965). (In German).

The developments in the design of boiling-water reactors since the construction of the Kahl VAK reactor are summarized. Potential further developments in this reactor type are indicated. (J.S.R.)

8367 NUCLEAR SYSTEMS ANALYSIS. Gunson, W. E.; Restelli, E. F. Jr.; Wright, J. H. (Westinghouse Electric Corp., Pittsburgh). Chem. Eng. Progr., 61: 68-71(Nov. 1965).

It is shown that chemical engineering and chemical engineering analysis techniques apply in many problem areas of nuclear reactor systems (with reference to pressurized-water reactors). Problems in heat and mass transfer and transient chemical kinetics are considered. (M.C.G.)

8368 BOILING WATER NUCLEAR REACTORS. McNelly, M. J.; Huntley, H. W.; Burley, E. L. (General Electric Co., San Jose, Calif.). Chem. Eng. Progr., 61: 72-4(Nov. 1965).

Boiling-water reactor design and development progress, with emphasis on the contribution of the chemical engineer, is reviewed. Principles of operation of boiling-water reactors are described and important areas of engineering design are discussed. Design of steam separators and jet pumps and project management are emphasized. (M.C.G.)

8369 HIGH TEMPERATURE GAS-COOLED NUCLEAR REACTORS. Simon, R. H.; Gitterman, M.; Webb, G. B. (General Dynamics Corp., San Diego, Calif.). Chem. Eng. Progr., 61: 78-81(Nov. 1965).

Chemical engineering aspects of high-temperature gas-cooled reactor systems, including heat transfer, adsorption, oxidation, and drying operations, are discussed. The Peach Bottom Power Reactor is described. The helium purification system is considered in detail. (M.C.G.)

8370 HETEROGENEOUS NUCLEAR REACTOR USING AN ORGANIC FLUID AS A MODERATOR AND AS A REFRIGERANT. de Gaudemaris, Gabriel. (to Commissariat a l'Energie Atomique. Institut Francais du Petrole des Carburants et Lubrifiants). German Patent 1,201,498. Sept. 23, 1965. Priority date Sept. 21, 1960, France.

The reactor comprises a mass of liquid hydrocarbons having a Factor G gas greater than 0.5 and a Factor G polymers greater than 0.75 which is circulated in the primary circuit, a secondary circuit with a vaporizable liquid connected to the primary circuit via a heat exchanger, a continual withdrawal circuit of a portion of the hydrocarbons, a furnace for burning the withdrawn portion of the hydrocarbons and for superheating the vapor produced in the secondary circuit, and a continuous replenishing circuit for adding to the mass of the hydrocarbons a portion of fresh hydrocarbons equal to the portion withdrawn. (Gmelin Inst.)

Fuels

Refer also to abstracts 7500, 7519, 7539, and 7573.

8371 (DP-1002) FUEL SPACER DEVELOPMENT. Richardson, George W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Nov. 1965. Contract AT(07-2)-1. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Full-length Zircaloy ribs, permanently attached to Zircaloy-clad fuel or to Zircaloy housing tubes and sized to produce minimum clearances, provide a reliable, proven method of spacing large, concentric nuclear fuel pieces to insure their integrity during power reactor operation. (auth)

8372 FUEL BUNDLES TAKEN TO DRYOUT IN NRU REACTOR. Winter, E. E.; Page, R. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Nucl. Technol., 4: 47-9(1965).

Twenty sets of measurements of the critical heat flux were obtained from nuclear fuel cooled by steam-water mixtures in the U-1 loop of the NRU reactor. The work was done with full 19-element fuel bundles. Preliminary examination of the results indicated that a six-bundle fuel string can be operated at powers at least as high as those predicted from out-reactor tests on electrically heated single bundles of similar geometry. (auth)

8373 FABRICATING PuO_2–UO_2 FUELS: HOW LEADING PROCESSES COMPARE. Biancheria, A.; Allio, R. J. (Westinghouse Electric Corp., Pittsburgh). Nucleonics, 23: No. 12, 46-50(Dec. 1965).

A comparison is made of the economics, physical properties, and in-pile behavior of PuO_2–UO_2 fuels fabricated by pelletization and by vibrational compaction of mechanically blended powders. Results of major PuO_2–UO_2 thermal fuels irradiation programs are summarized. Continuing programs at PRTR, EBWR, and the Saxton are briefly discussed. (L.B.S.)

8374 FUEL ELEMENT FOR NUCLEAR REACTORS. Salesse, Marc; Andre, Jacques; Gauthron, Maurice (to Commissariat a l'Energie Atomique). German Patent 1,200,965. Sept. 16, 1965. Priority date May 13, 1959, France.

A sheathed hollow cylindrical nuclear fuel element is described in which the sheath comprises a cylindrical inner sheet and a cylindrical outer sheet, the inner sheet at least being so constructed that when the sheathed element is subjected to the conditions within the reactor during operation that sheet will be plastically deformed by the cooling fluid to contact or maintain contact with the fuel. The inner sheet comprises lengthwise folds extending towards the sheath central axis. (Gmelin Inst.)

8375 FUEL ELEMENT FOR A NUCLEAR REACTOR. Huet, Andre German Patent 1,201,928. Sept. 30, 1965. Priority date May 13, 1959, France.

The fuel element consists of an hollow rod of fuel material extending upright through the mass of the liquid cooling medium in the core in which helical coolant flow is induced in the axial channel of the rod by means of helical channels in the wall of the rod extending from the outer surface of the rod to the central axially directed channel the two types of channels intersecting tangentially. (Gmelin Inst.)

Power and Power-Breeder Reactors

Refer also to abstract 8335.

8376 (ANL-6865) TERMINAL REPORT FOR THE MARK IV (PLUTONIUM) LOADING IN EBR-I. Smith, R. R.; Doe, C. B.; Haroldsen, R. O.; McGinnis, F. D.; Novick, M. (Argonne National Lab., Ill.). Apr. 1965. Contract W-31-109-eng-38. 92p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The Mark IV fuel loading for EBR-I consists of metallic Pu. The reactor is unmoderated and heterogeneous, and is designed for 1-Mwt operation with NaK coolant. The reactor design characteristics, dynamic properties, and breed-

ing ratio with this fuel loading and core configuration are described. (T.F.H.)

8377 (BLG–205) ESSAI DE MARCHE EN PUISSANCE DE LA CENTRALE NUCLEAIRE BR3 EN PRESENCE DE BORE DANS LE CIRCUIT PRIMAIRE. PREMIERE PARTIE: MARCHE AVEC 100 PPM DE BORE. (Test of Advance in Power in the BR3 Nuclear Power Station in Presence of Boron in the Primary Circuit. Part I. Advance with 100 ppm of Boron). Gueben, M.; Contzen, J. P.; de Greef, F.; Stacquez, P.; Beuken, G. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Aug. 1963. 40p. Dep. mn.

The importance of chemical shim for power reactors is increasing, and so does the need for some experiments to solve the various problems associated with this type of reactor. Such an experiment was undertaken at the BR3 power reactor. Preliminary tests and calculations – the first ones on water chemistry under the special conditions of operation with boron (no ion exchanger in the purification system, lower pH than usual), the second ones on safety associated with the dynamic behavior of the reactor in case of an accident – are achieved first. They show that the experiment is entirely practicable. Then a first step (operation at power with 100 ppm boron) is achieved. Boron is added progressively when the power station is at a power of 10 M(e) 85% of nominal power. The evolution of chemical parameters and of core reactivity is followed during stable operation. Secondary load transients are then introduced and the Xe transients are followed by varying the boron concentration, without moving any control rod. In this way, the primary water average temperature is maintained around 262°C with less than 1°C variation. After complete boron dilution, no special phenomenon appears (boron high-out, ...). (auth)

8378 (CVNA–244) MONTHLY OPERATING REPORT [ON CVTR OPERATION], SEPTEMBER 1965. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract AT(30-1)-2289. 41p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

CVTR performance, operation (at full design power of 65 Mw), maintenance, health and safety activities, and plant chemistry activities are reported. (T.F.H.)

8379 (CVNA–245) SIX MONTH OPERATING REPORT [ON CVTR OPERATION], APRIL 1–SEPTEMBER 30, 1965. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract AT(30-1)-2289. 82p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

CVTR operations, maintenance, performance, plant chemistry, health physics activities, and safety studies are reported. (T.F.H.)

8380 (CVNA–246) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report, April–June 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Contract AT(30-1)-2289. 85p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

CVTR operations, maintenance, performance, health physics activities, plant chemistry activities, and safety studies are reported. (T.F.H.)

8381 (CVNA–247) MONTHLY OPERATING REPORT [ON CVTR OPERATION], OCTOBER 1965. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract AT(30-1)-2289. 32p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

CVTR operations, maintenance, performance, health physics activities, plant chemistry activities, and safety studies are reported. (T.F.H.)

8382 (EURAEC–1447) RESEARCH PROGRAM FOR THE GARIGLIANO NUCLEAR POWER PLANT. Report No. 5. Quarterly Report No. 6. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). July 1, 1965. Contract 101-63-11-RD I. 9p. (EUR–2381). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Brief summaries of work accomplished during this period are presented for the data logging computer system, pressure vessel specimen irradiation, instrumented assemblies, and special studies and tests. (M.O.W.)

8383 (GA–6014) EXPERIMENTAL BERYLLIUM OXIDE REACTOR PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1964. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Jan. 28, 1965. Contract AT(04-3)-187. 43p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Further development of the EBOR facility is reported. The reactor core and associated components, control rod drive mechanism, component handling, instrumentation, and the pressure vessel and associated components are discussed. (M.O.W.)

8384 (GA–6510) EXPERIMENTAL BERYLLIUM OXIDE REACTOR PROGRAM. Quarterly Progress Report for the Period Ending June 30, 1965. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). July 28, 1965. Contract AT(04-3)-187. 32p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

During the quarter, analysis of the results of the thermal-pressure cycling tests of the 18-fuel-pin mockup continued. In the analysis, emphasis was placed on finding a possible mechanism for the fuel pin bowing phenomenon, and relating the test results to reactor operation in terms of low cycle strain fatigue. Elevated temperature testing of the tipping reflector pneumatic actuator was completed. The tests were terminated after the actuator performed satisfactorily when tipped at temperatures with different impulse pressures. First-phase testing of the control rod drive mechanism was terminated after 5000 oscillations when electrical trouble developed in the clutch coil and scram valve holding solenoid. Additionally, deficiencies with the modulating valve, scram motor seals, and accumulation of metallic powder in the positioning motor speed reducer were noted. After correction of deficiencies, the next phase of testing was terminated after 20,000 oscillations when sluggish movement of the control rod in the positioning mode was brought about by an accumulation of metallic powder in the speed reducer. General construction continued at the Idaho site with installations of mechanical, piping, electrical, and instrumentation systems. (M.O.W.)

8385 (GA–6649) THE DESIGN AND TESTING OF A PRE-COLLAPSED METAL CLADDING FOR USE IN THE EXPERIMENTAL BERYLLIUM OXIDE REACTOR. Bean, R. W. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Aug. 27, 1965. Contract AT(04-3)-187. 71p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The Experimental Beryllium Oxide Reactor, nearing completion at the National Reactor Testing Station, is designed for a peak power of 10 Mw(t). In order to achieve reasonable neutron economy with commercially available alloys, the fuel pin design employs a pre-collapsed cladding, achieved during manufacture by a high temperature, high pressure isostatic pressuring technique. Included is a summary of the development of the fuel pin concept from its inception and the results of both in-pile testing and out-of-pile thermal and pressure cycling tests. A theoretical analysis of cladding structural performance is also included. During the course of the development program, a rather severe thermal ratchetting problem was encountered which required for its solution a rather fundamental change in the original concept. This problem, together with its solution, is reviewed. Data on low cycle strain fatigue for pre-collapsed tubular cladding under pressure loading are also presented. (auth)

8386 (GEAP–4841) DEVELOPMENT OF PULSED NEUTRON APPLICATION TO POWER REACTOR START-UP PROCEDURES. 12th and 13th Quarterly Progress Report, January 1–June 30, 1965. Garelis, E.; Meyer, P.

(General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). July 16, 1965. Contract AT(04-3)-189. 35p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The neutron generator used in reactor startup is described. Reactor measurements and the pseudo-random impulse data acquisition system are discussed. Two papers which give details of the program are included. They are; "An Experimental Study of the ($k\beta/l$) Pulsed Neutron Source Technique in Light Water Assemblies," and "A Survey of Pulsed Neutron Source Methods for Multiplying Media." Only an abstract for the first paper is included. (M.O.W.)

8387 (GEAP-4954) TURBINE FLOWMETER CALIBRATION AND INSTRUMENTED FUEL ASSEMBLY PRESSURE DROP. GARIGLIANO DEVELOPMENT PROGRAM. Oliva, D.; Hench, J. E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Oct. 1965. Contract AT(04-3)-189. 63p. (EURAEC-1528). Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

Four pair of turbine flowmeters were tested to determine their calibration coefficients, or electrical output signal as a function of flowrate. The turbine flowmeters were tested with cold water at ambient pressure, with hot water at 1000 psia, and with steam-water mixtures at 1000 psia. The purpose of these turbine meters which are located at the inlet and outlet of a fuel bundle in the SENN reactor, is to determine the mass velocity and exit steam quality existing in the fuel bundle. In addition to calibration of the turbine flow meters, their pressure loss characteristics were measured and are presented. (auth)

8388 (IA-1057) SODIUM VOID AND DOPPLER COEFFICIENTS FOR FAST POWER REACTORS. Yiftah, S.; Gitter, L.; Ilamed, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Aug. 1965. 51p. Dep. mn.

Calculations were made in order to study the sodium void and Doppler effects in a series of fast reactors which differ in volume of core, type of plutonium fuel and composition of fuel. The sodium void and Doppler coefficients were obtained from criticality factors computed for 486 systems with the aid of multigroup diffusion theory for spherical systems. (auth)

8389 (KFK-299) REFERENZSTUDIE FUER DEN 1000 MWe NAGFIUMGEKUEHLTEN SCHNELLEN BRUTREAKTOR (Na 1). (Reference Study for the 1000 MWe Sodium Cooled Fast Breeder Reactor (Na 1)). Smidt, D.; Mueller, A. (comps.) (Kernforschungszentrum, Karlsruhe (West Germany)). Dec. 1964. 325p. Dep. mn.

A reference study for the 1000-Mw(e) sodium cooled fast breeder reactor (Na 1) is presented. The selection of the most important parameters, description of the entire installation, data tables, description of the reactor installation, reactor physics considerations and calculations, safety studies, structure and strength analyses, and economic calculations are discussed. In an appendix heat engineering design data of operational and planned reactor installations with Na cooling are tabulated. (J.S.R.)

8390 (LA-3431) QUARTERLY STATUS REPORT ON ADVANCED REACTOR TECHNOLOGY (ART) FOR PERIOD ENDING OCTOBER 31, 1965. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Nov. 1965. Contract W-7405-eng-36. 65p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Further development in the components of the proposed Fast Reactor Core Test Facility is reported. Results from fuel capsule testing in the Omega West Reactor are presented. The containers were carbonized and noncarbonized Ta and Ta-W alloys. The fuel was Ce-Co-Pu alloys. Research on plutonium fuels is discussed. Various properties of the fuels are given. Further developments in the Turret Reactor are reported, and also research on a plasma thermocouple is discussed. (M.O.W.)

8391 (LA-DC-7336) MOLTEN PLUTONIUM ALLOYS AS FAST REACTOR FUELS. Kirkbride, L. D. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 29p. (CONF-651009-9). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Conference on Safety, Fuels and Core Design in Large Fast Power Reactors, Argonne, Ill.

Molten plutonium alloys are being investigated by LASL as fuels for fast reactors. LAMPRE-I, a 1 Mw reactor experiment, utilized a Pu-Fe alloy of 16 g Pu/cc and demonstrated the feasibility of using molten alloys as reactor fuel. Current effort is being directed toward developing the less corrosive Pu-Co-Ce alloy system which will be employed in the LASL Molten Plutonium Burnup Experiment (MPBE). Results of current research and development regarding the Pu-Co-Ce fuel system are summarized. (auth)

8392 (NAA-SR-11450) ANNUAL TECHNICAL PROGRESS REPORT, AEC UNCLASSIFIED PROGRAMS, FISCAL YEAR 1965. (Atomics International, Canoga Park, Calif.). Nov. 10, 1965. Contract AT(11-1)-Gen-8. 436p. Dep. mn; CFSTI $7.00 cy, $2.00 mn.

Separate abstracts were prepared for the 7 included sections. (M.O.W.)

For abstracts of individual sections see: 8316, and 8393-8398.

8393 (NAA-SR-11450, Sect.1) SODIUM-REACTOR EXPERIMENT. (Atomics International, Canoga Park, Calif.). 21p.

Technical progress of the SRE Power Expansion Program (PEP) during the fiscal year 1965 is summarized. Separate discussions are presented for SRE-PEP engineering, SRE operations, SRE operational support, handling and shipment of radioactive waste materials to burial sites, SRE-PEP safety analysis, and the handling and shipment of source and special nuclear materials scrap to recovery sites. (M.O.W.)

8394 (NAA-SR-11450, Sect.2) LARGE SODIUM-GRAPHITE REACTORS. (Atomics International, Canoga Park, Calif.). 77p.

Progress toward the development of a 1000-Mw(e) SGR is reported. Discussions are given on the SGR design and evaluation, austenitic stainless steels for service in a high temperature sodium environment, UC fuel element development, LSGR fuel element development, development and evaluation of UC alloy fuel materials, UC process development, SRE Core III test elements, SGR dry control rod concept development, SGR dry control rod prototype development, SGR wet control rod conceptual development, SGR calandria structural tests, SGR calandria maintenance, and the SGR core maintenance, prototype development. (M.O.W.)

8395 (NAA-SR-11450, Sect.3) FAST-REACTOR DEVELOPMENT. (Atomics International, Canoga Park, Calif.). 69p.

A summary of progress on the fast reactor development program is presented. Separate sections are presented for the SCCR feasibility, evaluation, and design; calculational methods and cross sections, criticality calculations, boiling studies for sodium reactor safety, sodium fires and fission product release, and fuel element transient heating. (M.O.W.)

8396 (NAA-SR-11450, Sect.4) SODIUM-COMPONENT DEVELOPMENT. (Atomics International, Canoga Park, Calif.). 17p.

A summary of progress on the sodium component development program is presented. Brief discussions are presented on the operation of the sodium component test installation, installation of the ALCO steam generator, fabrication of modular steam generator, high-temperature strain measurements, and mechanisms in sodium. (M.O.W.)

8397 (NAA-SR-11450, Sect.5) SODIUM-COOLED REACTOR ADVANCED DEVELOPMENT. (Atomics International, Canoga Park, Calif.). 20p.

A summary of progress on the advanced development of

sodium-cooled reactors program is presented. Separate discussions are presented on contaminant removal techniques, large component test loop, evaluation of long term operation of SRE sodium systems and components, improvement of methods for making sodium-cooled reactor physics calculations, and SGR critical experiments. (M.O.W.)

8398 (NAA-SR-11450, Sect.6) HNPF-PNPF FUELS. (Atomics International, Canoga Park, Calif.). 35p.

Research work on HNPF and PNPF fuel elements is presented. Separate discussions are given for the HNPF fuel element surveillance and examination, HNPF Core I UC fuel element surveillance and examination, HNPF Core II UC fuel element surveillance, PNPF fuel element examination, PNPF Core II fuel element development, and PNPF Core II design. (M.O.W.)

8399 (ORNL-3872) MOLTEN-SALT REACTOR PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING AUGUST 31, 1965. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 163p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

Various aspects of MSRE operations and construction, engineering analysis, and component development during this period are discussed. Metallurgy, radiation chemistry, and fuel chemistry research is discussed. (M.O.W.)

8400 (ORNL-P-1784) NUCLEAR AND FUEL-CYCLE PERFORMANCE OF MOLTEN-SALT BREEDER REACTORS. Bauman, Howard F.; Kasten, Paul R. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 15p. (CONF-651101-47). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 13th Conference on Remote Systems Technology, Washington, D. C.

Thermal- and intermediate-energy molten-salt reactors appear capable of fuel doubling times in the range of 10 to 20 years, specific inventories of about 1 kg fissile/Mw(e), and fuel-cycle costs under 0.4 mill/kwhr. Thermal systems are graphite-moderated and fueled with circulating molten salts consisting of the fluorides of uranium, thorium, lithium-7, and beryllium. Intermediate systems are similar but without graphite moderator. The results presented are based on 1000-Mw(e) plants having 45% efficiency and 80% plant factor. The calculations were performed with OPTIMERC, an optimization code combined with the MERC multigroup, equilibrium reactor code. (auth)

8401 (WAPD-T-1732(Rev.)) CONTROL-INDUCED XENON OSCILLATIONS. Margolis, S. G.; Curlee, N. J. Jr. (Bettis Atomic Power Lab., Pittsburgh, Pa.). July 1964. Contract AT(11-1)-Gen-14. 26p. (CONF-654-99). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964.

Small-perturbation theory is used, in conjunction with an analog simulation to analyze the spatial reactivity oscillations produced by spatial oscillations of fission-product xenon in pressurized-water power reactors having large cores. The cases of no control, automatic control, and manual control are considered separately. (T.F.H.)

8402 (WCAP-6076) EFFECTS OF FUEL BURNUP ON REACTIVITY AND REACTIVITY COEFFICIENTS IN YANKEE CORE I. Poncelet, C. G. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Oct. 1965. Contract AT(30-1)-3017. 93p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The burnup dependence of moderator temperature coefficient and excess reactivity in a pressurized-water reactor is analyzed. Calculations are compared with measurements from the first Yankee core. For the moderator temperature coefficient studies, burnup effects receive a physical interpretation. Comparisons between two calculational models with dissimilar treatments of the thermal energy range (the LASER and LEOPARD codes) are described, and differences evaluated. Finally, specific influences, such as non-uniform material distributions in depleted fuel rods and thermal scattering kernels, are evaluated. (auth)

8403 EFFORTS TO RAISE TEMPERATURES IN CONVENTIONAL AND NUCLEAR POWER STATIONS. Leval, A. (Technical Univ., Budapest). Acta Tech. Acad. Sci. Hung., 50: 181-201(1965).

In accordance with fundamental laws of thermodynamics, efforts are made to raise the temperature at which heat in energy sources is released and transformed into mechanical or electrical power. Various limitations on reactor operating temperatures are considered, and a twin-flow heat removal scheme is evaluated. It is concluded that improved thermodynamics and temperature equalization can considerably reduce capital investment costs. (TCO)

8404 OPTIMIZATION OF LAMINATED SHIELDS. Enginol, T. B. (GKSS, Reaktorstation, Geesthacht, Ger.). Atomkernenergie, 10: 435-42(Nov.-Dec. 1965). (In German).

The problem of shield optimization for mobile reactors and reactors for power plants is to minimize the costs or weight of the shielding system keeping the dose rate at a given tolerable level. Even approximating expressions for the dose rate function are too complicated for an analytical approach. The dose rate function is supposed to be given by some digital computer programs, where any shielding code can be used for this purpose. It is generally known that in a first approximation the dose rate depends exponentially on the variations of the shield thickness. A weight function is defined in such a way that weight and/or costs/cm^3 appear linearly as weight factors to the shield volumina. This function, given in cylindrical and spherical geometry, is monotone increasing in shield thickness. The minimum of the weight function is found analytically with the constraint that the approximated dose rate remains smaller than a given value. The desired solution is then obtained by iteration. It is seen that for an optimum the choice of shield materials must be such that, stronger weighed shields must have smaller dose relaxation lengths. For an optimal arrangement, the weight of shields must decrease in outward direction whereas the corresponding relative increase in dose relaxation lengths must be weaker. (auth)

8405 GUNDREMMINGEN NUCLEAR POWER PLANT-ITS PLACE IN THE GERMAN ATOMIC ECONOMY. Mandel, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Atomwirtschaft, 10: 564-5(Nov. 1965). (In German).

The place of the Gundremmingen nuclear power plant in German atomic economy is indicated. The expected development of nuclear power is discussed. Placement of orders for reactor components, transportation precautions, and the financing of the Gundremmingen reactor are reported. The reactor is scheduled to go into power operation in the middle of 1966. (J.S.R.)

8406 SELECTION OF THE SITE. Ellmer, M. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Atomwirtschaft, 10: 567-8(Nov. 1965). (In German).

The Gundremmingen site of the KRB is the second taken into consideration. It was selected because the first site selection (Bertoldsheim) was refused by the water authority. The advantages of the first site and of the second are compared. (J.S.R.)

8407 PLANNING OF THE PUTTING IN OPERATION SCHEDULE [OF GUNDREMMINGEN]. Staebler, K. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Ger.); Zorkoczy, A. v. Atomwirtschaft, 10: 569-71(Nov. 1965). (In German).

The principal phases of operational startup are outlined. The tasks and classification of the operation personnel are given, and the organization of the startup is summarized. (J.S.R.)

8408 CONSTRUCTION OF THE ENTIRE INSTALLATION [GUNDREMMINGEN]. Ringeis, W. K. (AEG Allgemeine Electricitaets-Gesellschaft, Frankfurt am Main); Strassser, W.; Peuster, K. Atomwirtschaft, 10: 575-88 (Nov. 1965). (In German).

The basic concept of the KRB nuclear power plant at Gundremmingen (a two-circuit boiling water reactor) is discussed. The characteristics of the nuclear steam production system are described. Technical data for the power plant are tabulated. The turbines and the principal heating circuit are described. The nuclear auxiliary installation and the control and instrumentation of the plant are considered. The mechanical engineering auxiliary installations are indicated. (J.S.R.)

8409 THE [KRB] REACTOR. Schmale, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen); Schober, W.; Richardson, L. S.; Bigge, W. B. Atomwirtschaft, 10: 590-4(Nov. 1965). (In German).

The KRB reactor contains design changes from existing boiling-water reactors such as steam drying within the reactor, internal measurement of the neutron flux, a different type of neutron absorber screen, and changes in the core construction. The construction and nuclear design of the reactor, fuel elements, control rods, absorber screens, and neutron sources are described. Measurement of the neutron flux within the reactor, and detection of defective fuel elements are discussed. (J.S.R.)

8410 THE [KRB] ELECTRICAL INSTALLATION. Peuster, K. (Betriesfuehrungsgessellschaft HDR, Kahl, Ger.). Atomwirtschaft, 10: 602-4(Nov. 1965). (In German).

The KRB installation is connected with the 220-kv output of the RWE and the 110-kv output of the transmission system. The plant feed installation consists of two simple bus bars. Additional electronic constituents are the direct-current installation, the illumination installation, and the a-c net for measurement and control instruments, which can be fed in an emergency from batteries. (tr-auth)

8411 SPECIAL DEVICES OF THE KRB NUCLEAR POWER PLANT. I. NUCLEAR AUXILIARIES. Spierling, H. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main); Maierhofer, L. Atomwirtschaft, 10: 605-10(Nov. 1965). (In German).

For operational safety and the control of perturbations and incidents, a series of auxiliary units were installed in the KRB. Installations such as the poisoning unit, emergency condensation equipment, and spraying apparatus are in readiness for abnormal operational behavior. Other devices of this category serve in steam production, in the synchronization of maintenance works, in the collection of radioactive wastes, and in fuel element exchange and placement. (tr-auth)

8412 SPECIAL DEVICES OF THE KRB NUCLEAR POWER PLANT. II. REACTOR CONTAINMENT VESSEL. Haussmann, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Atomwirtschaft, 10: 611-15 (Nov. 1965). (In German).

The reactor containment vessel of the KRB was designed, constructed, and tested with all conceivable safety factors in order to maintain its function as an absolute safety shield for the greatest possible incident. The appearance of surface breaks on the weld seams after the first pressure tests caused the air locks and nozzles to be pulled out and replaced. The second pressure tests were satisfactory. (tr-auth)

8413 SPECIAL DEVICES OF THE KRB NUCLEAR POWER PLANT. III. INSTRUMENTATION. Ettemeyer, R. (Kernkraftwerk RWE-Bayernwerk AG, Gundremmingen, Ger.). Atomwirtschaft, 10: 616-17(Nov. 1965). (In German).

The nuclear power plant is monitored, operated, and controlled from a central control room in the operations building. All measurement parameters necessary are registered in the control room. Operational states that can lead to the endangering of the installation are optically and acoustically indicated. Rapid disturbance recorders register the most important information necessary for clarification of the disturbance. Since conventional instrumentation does not deviate from that of a conventional power plant, only the nuclear instrumentation is considered. (tr-auth)

8414 SPECIAL DEVICES OF THE KRB NUCLEAR POWER PLANT. IV. REACTOR CONTROL AND LOAD CONTROL. Heining, U. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Atomwirtschaft, 10: 618-21(Nov. 1965). (In German).

Control of the KRB reactor is accomplished by 89 control rods that can be lifted by the reactor drive only individually. Since the total output of the turbines is divisible into primary and secondary output, the same total output can be obtained with different control rod positions or different outputs with fixed control positions. A significant output interval can be over- or under-controlled without movement of the rods. (tr-auth)

8415 SPECIAL DEVICES OF THE KRB NUCLEAR POWER PLANT. V. REACTOR SAFETY. Peuster, K. (Betriebsfuehrungsgesellschaft HDR, Kahl, Ger.); Heining, U. Atomwirtschaft, 10: 622-3(Nov. 1965). (In German).

The reactor safety built into the electric circuits can release ventilation and diffusion seals in addition to activating trip mechanisms and emergency condensation devices. The feed of the reactor safety circuits is obtained from the two 220-v batteries. The startup sections operate auxiliary relays whose contacts interlock in three parallel disconnect lines. Disconnection by multiple excitation follows in 2 of 3 or 3 of 6 values. (tr-auth)

8416 SPECIAL DEVICES OF THE KRB NUCLEAR POWER PLANT. VI. WASTE TREATMENT. Queiser, H. (Allgemeine Elektricitaes-Gesellschaft, Frankfurt am Main); Mueller, A. Atomwirtschaft, 10: 624-6(Nov. 1965). (In German).

Radioactive wastes of the KRB are treated in the processing installation and released into the Donau after dilution to at least 10^{-7} mc/cm^3. Concentrates and spent resins are stored. Gaseous wastes are taken to the off-gas installation in which the free hydrogen and oxygen constituents are catalytically burned. The usual radioactive off-gases are allowed to decay before they are released to the stack. (tr-auth)

8417 RADIATION PROTECTION FOR NUCLEAR PLANTS AND THE ENVIRONMENT. Fender, H. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main); Knoerzer, G. Atomwirtschaft, 10: 627-31(Nov. 1965). (In German).

The control area and the vicinity are monitored by a thick net of radioactivity and radiation measurement sites. Radiation protection equipment includes the reactor shielding and the usual safety equipment of the installation as well as numerous circuits for monitoring and recording radioactivity. In all areas in which radioactive contaminated waters can penetrate by leaks, special decontamination precautions are taken. Individual personnel monitoring is done by film packets and pocket dosimeters. A 118-m measurement pole is used for meteorological measurements. (tr-auth)

8418 SPECIAL CONSTRUCTION PROBLEMS [GUNDREMMINGEN]. Boernke, F. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Atomwirtschaft, 10: 631-4(Nov. 1965). (In German).

Evaluation of the Gundremmingen area for reactor construction is discussed. The peculiarities of the construction are described and the survey work is summarized. (J.S.R.)

8419 COMPLETION OF THE ASSEMBLY [GUNDREMMINGEN]. Facius, H. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main). Atomwirtschaft, 10: 635-8(Nov. 1965). (In German).

Completion of the assembly work in the waste processing building, the reactor building, and the machine house is described. (J.S.R.)

8420 WR-1 TYPE REACTOR PROPOSED FOR SPAIN'S DON. Chase, D. B. A. Can. Nucl. Technol., 4: 42-3(1965).

Based on experience in the construction of the NPD and WR-1 reactors, a design was proposed for an organic-cooled, heavy water-moderated prototype power reactor

for the Junta Energia Nuclear in Spain. The reactor is similar to the WR-1 reactor in Whiteshell, Manitoba, but with additional channels to increase thermal output to 106.5 Mw and to give a 30 Mw(e) output as a prototype power reactor. (auth)

8421 THE CPI, A SOURCE OF NUCLEAR POWER ENGINEERS. Hoyle, A. C. (Canadian General Electric Co., Ltd., Peterborough, Ontario). Chem. Eng. Progr., 61: 75-7(Nov. 1965).

Recovery of heavy water, safe discharge of fission products, radioactive materials handling, and process control in nuclear power plants are considered. The NPD process systems are described. (M.C.G.)

8422 TRANSIENT ANALYSIS FOR NUCLEAR POWER REACTORS. Griffin, C. W.; Rumpf, N. K. (Atomics International, Canoga Park, Calif.). Chem. Eng. Progr., 61: 81-4(Nov. 1965).

Mathematical techniques for performing analyses on nuclear reactor systems are discussed. It was found that by adhering to small signal theory most of the analytical techniques applied to other process systems could also be used in analyzing a reactor. Basic nuclear considerations in analyses, reactor malfunction analysis, basic mathematical techniques, oscillation techniques, and power spectral density analysis are discussed. (M.C.G.)

8423 NEW REACTORS SHAPE POWER SYSTEMS. Wright, J. H. (Westinghouse Electric Corp., Pittsburgh). Elec. World, 164: 76-9; 125-6(July 12, 1965).

Some prospects for nuclear power system development are presented. Economic and technical aspects are examined for reactor types which appear to hold the most promise. (TCO)

8424 TURBO-MACHINERY FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. Engineer, 219: 1011-13(June 11, 1965).

The type of turbo-machinery likely to be required for a 250-Mw set of generators installed in the helium-filled primary circuit of a nuclear reactor of the Dragon type is considered. The fluid flow cycle of the primary circuit is illustrated. The turbo-machine has two shafts: the compressors and turbine which drives them are mounted on one shaft; the power turbine which drives the electric generator is mounted on a separate shaft. From the characteristics of the compressor, for which the pressure ratio and the efficiency are plotted against the non-dimensional mass flow function, a working point was chosen to suit the Dragon cycle, at a pressure ratio a little below 2.6. Modifications of the compressor for helium are discussed, and turbine design is considered. (L.B.S.)

8425 DESIGN STUDY OF PRESSURIZED HEAVY-WATER COOLED POWER REACTOR. Yokosuka, Masatoshi (Mitsubishi Atomic Power Ind., Inc., Japan). Genshiryoku Hatsuden, 8: 51-61(Sept. 1964). (In Japanese).

An outline is given of the closed-cycle, pressurized heavy-water type, power reactor, designed by Mitsubishi Atomic Power Industry, Inc. The thermal power output is 1163 Mw and the electric power output is 345 Mw. The reactor core has a total of 500 longitudinal pressure cold-tubes. The dimensions of the core are 5.57 m in height and 6.31 m in diameter. The reactor core is surrounded by two layers of reflector, first by heavy water and then by ordinary water. The nuclear fuel employed is rods of natural uranium combined with depleted UO_2, cladded in Zircaloy tubes, and a total of 47,500 such rods are used in the core. The average thermal neutron flow is 1.2×10^4 n/cm^2 · sec; the average neutron flow is 6.3×10^3 n/cm^2 · sec; the average burnup is 8000 Mwd/ton; and the average power density is 6.68 kw/l. The pressure of the cooling heavy water is 102 atm; four steam generators are employed for the heated heavy water. Heavy water is used as the moderator in the tank. The reactor control is done by control rods and by moderator poisoning. (NSA of Japan)

8426 DERIVATION OF BWR CORE DYNAMICS MODELS AND ANALYSIS OF JPDR CORE TRANSIENT TESTS. Mochizuki, Keiichi (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 377-90(Oct. 1965).

A core dynamics model was established for the JPDR plant (natural circulation boiling water reactor plant). First, upon surveying the analytical model with the so-called distributed parameters in reference to the experimental results obtained during the JPDR initial power-up test, the core dynamics model was developed with lumped rather than distributed parameters, and to further modify it to obtain the highest possible accuracy. Three equations for mass, energy and momentum balances were used, and particular care was taken in the determination of the core void fraction and recirculation flow, the development of the thermohydrodynamic equation in the saturated region, and the choice of void sweep time as well as various numerical constants. The derived dynamics model was then applied to the analysis of the JPDR transient test involving Bypass Regulator and Initial Pressure Regulator operations, as well as to that of the Bypass Regulator oscillation test. The calculated results by this model agreed well with data from experiment. A comparison was then made between the model and other core dynamics models. It was concluded that this model intrinsically has good accuracy and is easy to handle; it should prove very useful for core dynamics analysis of any BWR, in their relation to the out-of-core controlling system. (auth)

8427 SAFETY ASPECTS OF THE 20 MW REACTOR EXPERIMENT KNK. Huebel, H.; Mausbeck, H. (INTERATOM GmbH, Cologne). Kerntechnik, 7: 433-41(Oct. 1965). (In German).

A description is given of typical safeguards and safety aspects for a sodium-cooled thermal nuclear power plant: The high boiling point of the coolant permits a low pressure layout of reactor and coolant loops. Inert-gas filled cells house the reactor and the primary coolant loops and make sodium fires caused by sodium leakages incredible. Special safety devices ensuring the integrity of the primary system, prevent damages in the primary system as a consequence of sodium-water reactions in case of a pipe burst in the steam generator. Nuclear excursions are controlled by the safety system of the reactor plant. All credible accidents demand only a gastight lay-out of the safety container. (auth)

8428 MEASURING PROBLEMS IN NUCLEAR PLANTS. Ettemeyer, R. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Ger.). Kerntechnik, 7: 442-5(Oct. 1965). (In German).

Operating experience on the nuclear instrumentation of the Kahl experimental nuclear plant is presented. Measuring difficulties are indicated resulting from the variation of neutron flux density distribution along the core height of different power levels. Proposals are made to avoid the present difficulties at future nuclear plants. (auth)

8429 CORROSION PRODUCT BEHAVIOR IN STAINLESS-STEEL-CLAD WATER REACTOR SYSTEMS. Taylor, G. Russell; Cohen, Paul (Westinghouse Electric Corp., Pittsburgh). Nucl. Appl., 1: 446-52(Oct. 1965).

Chemical and radiochemical analyses of fuel cladding materials, cladding corrosion-product films and deposits, and circulating corrosion products for the Yankee and Saxton nuclear power reactors are presented. In the neutral water chemistry of the Yankee Plant, the circulating corrosion products and deposits have similar chemical composition, exhibiting primarily chromium depletion with respect to the base metal; the corrosion film is highly enriched in chromium and depleted in iron relative to the base metal. In the Saxton water chemistry (boric acid with potassium hydroxide added) the circulating corrosion products are similar to the base metal in composition, and correspondingly, the chromium content of the film is significantly lower than that of the Yankee corrosion film. The specific activity of the metallic elements in both cases decreased in the order: clad,

film, deposit, and circulating corrosion products. The pronounced decrease in activity from the clad to the film indicated that even the corrosion oxide film is largely deposited rather than originating from the local base metal. From the specific activity of the circulating insoluble corrosion products, it is difficult to explain quantitatively the observed radiation levels external to the reactor cores. (auth)

8430 DUNGENESS B NUCLEAR POWER STATION. Nucl. Energy, 296-303(Oct. 1965).

A report is given on the assessment of the successful advanced gas cooled reactor (AGR) submitted by Atomic Power Constructions, Ltd., and the next most attractive offer, the BWR submitted by The Nuclear Power Group in association with the International General Electric Co. of America for the Dungeness "B" power station. In addition the cost of power produced from the accepted design for Dungeness "B" is compared with that available from Wylfa, the latest magnox station now being built, and from a coal fired station of the latest available design situated in an area where fuel costs are the lowest available to the Board. The assessment was thorough. It is hoped that the results presented will be of value to electricity supply undertakings throughout the world. (auth)

8431 THE DRAGON PROJECT. Nucl. Energy, 303-12 (Oct. 1965).

A condensed report is given on the Dragon project, which includes summaries on the work experience and developments on the first core loading, engineering research, leak testing, fuel element corrosion, graphite corrosion, carbon deposition, coolant processing, fuel elements, performance of the first core, graphite, fuel kernel developments, coating, irradiation program, and post-irradiation examination. Site erection and testing, reactor operation, and power reactor assessment are also reviewed. (L.B.S.)

8432 SOME NOTES ON DYNAMIC STRUCTURAL PROBLEMS IN THE DESIGN OF NUCLEAR POWER STATIONS. Gluckmann, Alexis L. (Gibbs and Hill, Inc., New York). Nucl. Struct. Eng., 2: 419-37(Oct. 1965).

Some dynamic problems in structural engineering as applied to the design of nuclear power stations are discussed. The following problems are analysed: seismic design, steam generator supports, design of fluid containers, the missile problem. (auth)

8433 DESIGN AND CONSTRUCTION OF THE WELDED STEEL HULL OF THE 237 MW NUCLEAR POWER PLANT AT GUNDREMMINGEN. Laufer, M. Stahlbau, No. 1, 6-13(Jan. 1965). (In German).

Design details and welding technology for the assembling of the BH 51 steel hull of the Gundremmingen nuclear power plant are given. Computation of tolerable stresses, testing welds by bead on plate-bend tests, hardness measurements and pressure tests at 4.75 atm gage pressure are described. (Rev. Metal Lit.)

8434 ENRICO FERMI ATOMIC POWER PLANT—IRRADIATION TEST FACILITY. Huebotter, P. R.; Jens, W. H. (Atomic Power Development Associates, Inc., Detroit). New York, American Society of Mechanical Engineers, 1965, Preprint No. 65-WA/NE-5, 6p., $1.50. (CONF-651110-20). ORINS.

From American Society of Mechanical Engineers, Annual Winter Meeting, Chicago.

The initial operation of the Enrico Fermi Fast Breeder Reactor will be at 110 Mw(t) using the fuel presently on hand. Plans are being made to use the facility during this initial period of operation for sponsored irradiation tests of improved fast reactor fuels and nonfissionable materials such as fuel element claddings and materials of construction. The capabilities of the Fermi reactor as an irradiation test facility are presented. Thermal performances of typical fast reactor fuel elements are given, as are comparative irradiation damage rates to austenitic stainless steel in Fermi and in the 1000-Mw(e) fast breeder reactor expected to be constructed in the future. (auth)

8435 DEEP-OCEAN REACTOR PLACEMENT STUDY. Quirk, John (Naval Civil Engineering Lab., Port Hueneme, Calif.). New York, American Society of Mechanical Engineers, 1965, Preprint No. 65-WA/UNT-11, 7p., $1.50. (CONF-651110-25). ORINS.

From American Society of Mechanical Engineers, Annual Winter Meeting, Chicago.

The results of a study pertaining to handling of heavy weights in the deep ocean are described. The problem of placing a 155-ton nuclear reactor on the deep-ocean floor at depths up to 20,000 ft is considered. The study recommends that the major portion of the weight of the reactor be buoyed with a large syntactic foam float. The slightly negatively buoyant assembly is lowered with a 4-in-dia polypropylene line from a converted T-2 tanker. When in place, the reactor floats above the bottom, supported by the syntactic float and anchored by an embedment anchor. (auth)

8436 EVOLUTION OF GAS REACTOR STEAM GENERATORS. Grotz, B. J.; Lorenzen, A. M. (C. F. Braun and Co., Alhambra, Calif.). New York, American Society of Mechanical Engineers, 1965, Preprint No. 65-WA/NE-8, 10p., $1.50. (CONF-651110-23). ORINS.

From American Society of Mechanical Engineers, Annual Winter Meeting, Chicago.

The evolution of steam generator designs for gas-cooled power reactors is described from the development of an initial concept on a study for the FWCNP system, through design of consecutively more advanced concepts for EGCR and HTGR. The flow patterns within the steam generators are described, as are design features required to meet the specific operating conditions. The EGCR and HTGR units have been built and installed. (auth)

8437 SPHERICAL FUEL ELEMENT FOR HIGH-TEMPERATURE POWER REACTORS. Rachor, Lothar (to NUKEM Nuklear-Chemie und -Metallurgie GmbH). German Patent 1,202,910. Oct. 14, 1965. Filed May 7, 1963.

The fuel element consists of a hollow sphere of graphite to the inner surface of which a layer of fissionable or fertile material is applied. The remaining central space is filled with graphite. (Gmelin Inst.)

Process Heat Reactors

Refer to abstract 8423.

Propulsion and Space

See also ENGINEERING — Space Propulsion

Refer also to abstracts 7249 and 7988.

8438 (AE-63-0011) RE-ENTRY AND DISPOSAL PHENOMENA FOR NUCLEAR AUXILIARY POWER SYSTEMS. Fifth Quarterly Report, October 1—December 31, 1962. (General Dynamics/Astronautics, San Diego, Calif.). Dec. 31, 1962. Contract AF 29(601)-4893. 42p.

The thermal environment experienced by fuel elements ejected from rocket vehicles at altitudes of 90 to 110 kft is studied analytically, for various ejection angles, ejection velocities, initial temperatures, and end-over-end tumbling rates. In no case studied do the results indicate melting of the unclad U—Zr fuel rods. (T.F.H.)

8439 (KR-97) SEMI-ANNUAL PROGRESS REPORT, JANUARY-JUNE 1965. Aabakken, Bjarne (ed.) (Institutt for Atomenergi, Kjeller (Norway)). Oct. 1965. 84p. Dep. mn.

During the first half of the year the work at Kjeller was to a great extent concentrated upon the completion of the first reference design of the Marine Reactor Project. Several aspects of the marine reactor development and design are discussed. The research reactor JEEP II is nearing its

completion, and a detailed description of its control and instrumentation system is presented. Also included are reviews of the work performed in the fields of neutron physics, chemistry, metallurgy, isotopes, education, and health and safety. A brief review of studies in connection with landbased nuclear power stations is also given. (M.O.W.)

8440 (NAA-SR-Memo-11418) FS-4 DIFFERENTIAL CURRENT TRANSDUCTOR PERFORMANCE EVALUATION. Smith, A. K. (Atomics International, Canoga Park, Calif.). July 9, 1965. Contract AT(11-1)-Gen-8. 15p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The performance characteristics of the differential current transductor used on the FS-4 flight system were evaluated. The results of this evaluation indicate that the transductor can provide an accurate measure of leakage current when properly corrected by the use of end-to-end calibration data. An additional small temperature correction can also be applied. Equations defining the correction terms are developed and reported. Instrument accuracy is estimated. (auth)

8441 (NAA-SR-Memo-11435) EFFECT OF OVERVOLTAGE ON MAIN RELAY BOX STARTUP RELAYS. Klinkner, K. C. (Atomics International, Canoga Park, Calif.). June 10, 1965. Contract AT(11-1)-Gen-8. 7p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A set of SNAP 10A startup relays is subjected to overvoltages up to and including 50 v d-c. The testing is conducted at ambient pressure and temperature. The test voltage is applied to the relay coils for a duration sufficient to insure temperature equilibrium. No catastrophic failures are observed. (auth)

8442 (NASA-CR-54758) REPLACEMENT OF ELECTRONICS WITH FLUID INTERACTION DEVICES. Summary Report, Task-1. Cardon, M. H. (Bendix Corp., Southfield, Mich. Research Labs. Div.). Aug. 31, 1965. Contract NAS 3-6201. 160p. (BRLD-2946).

Efforts devoted to design and analysis of an actuation system that uses fluid circuits instead of electronics are discussed. The objective is to develop an all-pneumatic servo actuator with performance equal to the electropneumatic unit and with greater reliability in adverse environments. The system is designed to use a piston-cylinder with rack and pinion that produces 180° rotary output. Design features include a 6 cps bandwidth, 0.2 degrees resolution, and 300 in.-lb stall torque. The working fluid is dry H_2 with 215 psia supply and 50 psia exhaust. Experimental data on vortex amplifiers for this system are included. (auth)

8443 (NASA-CR-54776) FABRICATION AND TEST OF A FLUERIC POSITION SERVO. Quarterly Report, June 10-September 10, 1965. (Bendix Corp., Southfield, Mich. Research Labs. Div.). Contract NAS-3-6201. 19p. (BRLD-3133). CFSTI $1.00 cy, $0.50 mn.

A layout drawing defining the mechanical configuration of a flueric circuit was completed, and a breadboard vortex amplifier was designed and built. A brief description of the actuation system previously designed is included. (P.C.H.)

8444 (NASA-TN-D-3119) ANALYSIS OF THE EFFECT OF A SEEDED PROPELLANT LAYER ON THERMAL RADIATION IN THE NOZZLE OF A GASEOUS-CORE NUCLEAR PROPULSION SYSTEM. Howell, John R.; Renkel, Harold E. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Dec. 1965. 17p. CFSTI $1.00 cy, $0.50 mn.

An analysis is made of the radiative flux expected in the nozzle of a coaxial-flow gaseous-core nuclear propulsion system. The values of flux are shown to be extremely high when judged by present standards of nozzle cooling. The effect of seeding a layer of propellant at the nozzle wall with a highly radiation-absorbing material is then examined analytically. Reductions of two orders of magnitude in the radiative flux at the nozzle wall are predicted for some seeding levels. These reductions were obtained by conditions corresponding to less than 5 percent by weight of seeding material in a seeded layer of one-tenth the local nozzle radius. These figures are based on assumptions which involve mixing within the bulk propellant and the seeded layer. (auth)

8445 (NYO-841-3(Rev.)) PROPOSED GAS AND AIR CLEANING SYSTEMS FOR ROVER ENGINE TEST STANDS (WITH SPECIAL REFERENCE TO FLOATING ROOF CONTAINMENT VESSELS). First, Melvin W.; Silverman, Leslie; Pender, Daniel; Dawson, Stanley (Harvard School of Public Health, Boston, Mass.). Nov. 1964. Revised Oct. 1965. Contract AT(30-1)-841. 65p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Decontamination systems for rocket engine exhaust gases are discussed. Requirements for the gas cleaning systems are discussed. The technical features and economics of gas holding systems, on-stream gas cleaners, and confinement systems of underground tunnels are discussed. (M.O.W.)

8446 (PWAC-456(Del.)) AN EVALUATION OF DIRECT AND INDIRECT CONDENSING RADIATORS FOR A 300-Kwe SNAP-50/SPUR POWERPLANT. Allen, John E.; Hoey, Matthew T.; Prendergast, Michael R.; Stello, Victor Jr. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Feb. 22, 1965. Contract AT(30-1)-2789. 25p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Direct condensing and indirect segmented radiators are compared for possible use with the SNAP-50/SPUR powerplant. The comparison is made on the basis of weight, materials selection, startup, off-design operation, and ground testing considerations. (auth)

8447 (PWAC-491) SNAP-50/SPUR FINAL SUMMARY REPORT [ON] COOLANTS AND WORKING FLUIDS. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Nov. 1965. Contract AT(30-1)-2789. 95p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The SNAP-50/SPUR powerplant design was based on the use of lithium as a reactor coolant, potassium for the Rankine cycle working fluid, and eutectic NaK for the condenser coolant. The work accomplished in a comprehensive program to establish the necessary coolants and working fluid technology is summarized. Investigations were conducted in five areas of technology: analytical chemical techniques; methods were developed to analyze the alkali metals to determine trace metal, oxygen, nitrogen, and carbon contaminants to assure the efficacy of purification methods and to aid in evaluation of experiments, purification and handling techniques; procedures were established to provide for personnel and equipment safety and to assure that reproducibly high quality alkali metals were used to test systems, thermophysical properties; the thermophysical properties of the alkali metals were evaluated, and selected properties were measured to provide increased confidence in the design of engineering components, corrosion theory; investigations performed on columbium-zirconium alloys led to an understanding of the corrosion mechanism and thresholds of corrosion for refractory metals and alloys. These experiments resulted in establishment of specifications designed to eliminate failures by corrosive action of the alkali, and compatibility evaluations; laboratory and engineering tests showed that properly processed Cb-1 Zr alloy was compatible with the SNAP-50/SPUR alkali metal environments for extended periods at high temperatures. Encouraging results were obtained in limited compatibility tests of PWC-11 (Cb-1 Zr-0.0.1C) alloy with lithium and potassium, but definitive loop tests were not completed when the technical program was terminated. (auth)

8448 NUCLEAR ROCKET REACTOR SHIELDING PROBLEMS. Budnick, D. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Atomkernenergie, 10: 443-6(Nov.-Dec. 1965). (In German).

Shielding mass requirements of a nuclear aerospace transporter (manned earth-to-orbit-and-return-vehicle) are treated, considering a 100 Mp thrust nuclear rocket reactor engine. (L.B.S.)

8449 INFLUENCES OF HEAVING AND LISTING ON HEAT FLUX AND HYDRAULIC CHARACTERISTICS OF NUCLEAR SHIP WATER-COOLED REACTORS, AND THE COUNTERMEASURES. Isshiki, Naotsugu Nippon Kikai Gakkai-shi, 68: 178-88(Feb. 1965). (In Japanese).

Burnout experiments were carried out on two simplified models of cooling loops for use in the water-cooled reactors; cyclic heavings and constant listings were applied to the models by a heaving apparatus, with the cyclic heaving motions of ±1.1 gravity amplitude and ±30° listing. The results obtained are as follows: (1) The critical heat flux falls off linearly with heaving acceleration, accompanied by violent cyclic fluctuations of the void and flow velocity. (2) When the loop is listed, the critical heat flux falls locally near both sides of the loop, accompanied by a sharp one-side concentration of the voids. From the theoretical study of these phenomena, it was found that there were resonance heaving frequencies of the loop, and critical subcooling temperatures of the core exit, where no void fluctuations occurred. In order to obtain a nuclear ship reactor, which operates safely even on very rough seas, it is important to take the following steps in the thermal and hydraulic design: (1) The falling of the critical heat flux by possible heaving and listing motions should be taken as one of the hot channel factors. (2) The core exit water temperature should be subcooled more than the critical subcooling temperature; this means the PWR-type is more suitable for nuclear ships than the BWR-type. (3) The circulating water velocity should be as high as possible. (4) The height of the core and of the riser should be as low as possible. It is desired that these results of the study will be used in the (first) nuclear ship of Japan Nuclear Ship Development Agency. (auth)

8450 AEROSPACE NUCLEAR PROPULSION TECHNOLOGY. Rothman, A. J. (Univ. of California, Livermore). pp 306-37 of Ceramics for Advanced Technologies. J. E. Hove; W. C. Riley (eds.). New York, John Wiley and Sons, Inc., 1965.

Nuclear reactors for aerospace propulsion systems are discussed. Both atmospheric nuclear propulsion and space nuclear propulsion are considered. The Aircraft Nuclear Propulsion and Pluto Projects are reviewed. Nuclear rockets are discussed. The solid-core nuclear heat exchanger (Project Rover) is considered in detail. (45 references). (F.J.H.)

8451 SNAP 8—GROUND PROTOTYPE NUCLEAR TEST FACILITY. Stolz, John F.; Di Pol, C. V. (Atomics International, Canoga Park, Calif.). New York, American Society of Civil Engineers, 1965, Preprint No. 250, 22p., $0.50. (CONF-651036-1). ORINS.

From American Society of Civil Engineers, Environmental Engineering Conference and Annual Convention, Kansas City, Kan.

The SNAP-8 Ground Prototype Nuclear Test Facility was designed to provide a high-vacuum environment for a shielded nuclear ground test of a compact SNAP-8 reactor coupled to a power conversion system. The environmental, containment, and reliability features are emphasized. A comparison of field test data to design criteria for the vacuum system is given. (auth)

8452 SNAP REACTOR TRANSIENT TEST MACHINE. Anderson, Thomas L.; Buttrey, Kenneth E.; Rochfort, Jean D.; Campbell, Robert D. (Atomics International, Canoga Park, Calif.). New York, American Society of Mechanical Engineers, 1965, Preprint No. 65-WA/SAF-1, 12p., $1.50. (CONF-651110-24). ORINS.

From American Society of Mechanical Engineers, Annual Winter Meeting, Chicago.

The evaluation of credible aerospace nuclear accidents frequently requires highly specialized test equipment. The Snaptran Transient Test Machine is such a device. Though the accident to be simulated seems straightforward—a compact reactor excursion resulting from a dry land impact—simulation of the excursion under controlled and reproducible conditions resulted in an unusual and complicated machine. The evolution of this device from a nuclear requirement to an operating machine and the test data acquired with the machine are discussed. (auth)

8453 SNAP 10A REACTOR OPERATION. Hawley, John P. (Atomics International, Canoga Park, Calif.). New York, American Society of Mechanical Engineers, 1965, Preprint No. 65-WA/NE-6, 7p., $1.50. (CONF-651110-21). ORINS.

From American Society of Mechanical Engineers, Annual Winter Meeting, Chicago.

The performance of the SNAP-10A ground test and flight system reactors is described. The ground test system operated in a simulated space environment continuously for nearly 6 months at full power. The flight system operated at full power for 43 days before an undetermined malfunction caused termination of the experiment. Both experiments served to demonstrate the feasibility of nuclear reactor auxiliary power in space. (auth)

8454 SNAP 10A THERMAL CONTROL COATINGS. Crosby, J. R.; Perlow, M. A. (Atomics International, Canoga Park, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1965, Preprint No. AIAA 65-652, 24p., $1.00. (CONF-650955-5). ORINS.

From American Inst. of Aeronautics and Astronautics, Thermophysics Specialist Conference, Monterey, Calif.

The development and qualification of radiation control coatings for the SNAP-10A system, which comprises a 30-kw(t) NaK-cooled reactor heat source and a thermoelectric power conversion system, are described. An integral part of the coating development program was the attainment of a low α_s/ϵ white coating for use on the SNAP-10A thermoelectric module and thermoelectric pump radiator fins. The reference design coating system utilized on the high-temperature (500–700°F) radiators is AI93 (ϵ = 0.91, α_s = 0.35). The composite AI93 coating system consists of a subcoat of chromium–cobalt–nickel spinel bonded with aluminum phosphate and a topcoat of stannic oxide bonded with aluminum phosphate. All tests associated with the qualification and optical measurement of this coating system in a simulated space and nuclear environment were successfully performed. These tests include: electron, neutron, proton, and gamma irradiation; ultraviolet irradiation; shock, vibration, and aerodynamic heating; and 8000-hour stability tests at 600°F in vacuum. During the SNAPSHOT mission, the "Stability of Surfaces Experiment" aboard the Agena vehicle did not provide direct data as to coating stability due to an electronic failure. However, the stability of the AI93 coating for a 43-day period was ascertained from analysis of power and temperature data obtained during the FS-4 flight test. During this 1000 hour operational period the surface emittance of the AI93 coating varied less than 2%. (TCO)

Research and Test Reactors

8455 (BNL-9654) IRRADIATION TECHNIQUES IN VERY HIGH FLUX REACTORS. Floyd, John J. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT(30-2)-Gen-16. 25p. (CONF-651117-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From IAEA Study Group on Irradiation Techniques at Research Reactors, Istanbul.

Irradiation of samples in very high flux reactors (fluxes greater than 5×10^{14} n/cm^{2}sec) creates special problems. Problems discussed include high heating rates, high levels of induced radioactivities, encapsulation, impurities, and fast neutron reactions. Differences in techniques used in very high flux reactors and medium flux reactors are pointed out. Three very high flux reactors in the United States are cited. They are: the HFBR at BNL, the HFIR at ORNL, and the Savannah River High Flux Demonstration at Savannah River. The HFBR at Brookhaven is described briefly with some detail given to the irradiation thimbles. A table comparing the various characteristics of the HFBR and the Brookhaven Graphite Research Reactor, which is a

medium flux reactor, is presented. It is pointed out that it takes only about 2-3 months of full power operation of the HFBR to yield the equivalent thermal integrated flux (nvt) of 15 years of operation of the BGRR; and for the fast nvt, 3-4 days at the HFBR is equivalent to 15 years at the BGRR. (auth)

8456 (BNWL-SA-409) PRTR FUEL ELEMENT EXPERIENCE. Freshley, M. D.; Panisko, F. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 14, 1965. Contract AT(45-1)-1830. 12p. (CONF-651119-3). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Libby Cockcroft Information Exchange Meeting, Harwell, Eng.

Experimental tests to determine the fuel burnup in the PRTR are discussed. Results of coolant activities and fission release rates from defected packed-particle fuel elements of the PRTR are presented. Diagrams of several of the defected fuel elements are given. (M.O.W.)

8457 (EUR-2551.e) FLUB—A 7090 PROGRAM FOR THE DETERMINATION OF LATTICES BUCKLING BY FLUX-MAPPING. Di Cola, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center. European Atomic Energy Community, Ispra (Italy). European Scientific Data Processing Center). Aug. 30, 1965. 24p. Dep. mn.

The aim of the FLUB program is the data processing of ECO flux mapping measurements. The first part of the program makes the different foil activity corrections (background, deadtime of counts, radioactive decay). The second part fits the corrected values to a function of the form; $\phi = A\, J_0\,(\beta r) \sin(\alpha z - \gamma)$. (auth)

8458 (EUR-2553.e) DYNAMICS AND CONTROL OF THE FAST PULSED REACTOR "SORA." Caligiuri, G. P.; Wundt, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center. European Atomic Energy Community, Ispra (Italy). European Scientific Data Processing Center). Aug. 13, 1965. 102p. Dep. mn.

A detailed description of the dynamic behavior of the reactivity-pulsed research reactor SORA is presented, based on results of a simulation on an analog computer. The periodically pulsed state is treated, as well as disturbances from it. Temperature feedback is considered. A suitable control is designed to keep the reactor stable though it becomes prompt-supercritical fifty times per second. The simulation itself required new combined digital-analog techniques which are equally described. (auth)

8459 (IDO-17036) SPERT III REACTOR FACILITY: E-CORE REVISION. Dugone, J. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Nov. 1965. Contract AT(10-1)-205. 124p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The Special Power Excursion Reactor Test III (SPERT III) reactor is a pressurized-water research reactor, constructed to provide a facility for conducting reactor kinetic behavior and safety investigations. The investigations are designed to provide information for the advancement of pressurized-water and boiling-water reactor technology and safety. The facility is designed for operation up to pressures of 2500 psig, temperatures of 650°F, and flows of 20,000 gpm and incorporates essential features typical of pressurized-water and boiling-water reactors. An updating is given of the original facility report. The engineering features of the reactor and supporting process equipment, with the E-core and other modifications that have been made made to date (1965), are described. (auth)

8460 (IOI-296) PERFORMANCE OF THE NRX SHUT-OFF RODS. Manson, R. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Aug. 1965. 30p. (AECL-2299). Dep.; AECL $1.00.

A new type of shut-off rod of electro-mechanical design was developed for the NRX reactor following the accident of 1952. Some problems were encountered with limit switch adjustment but minor modifications in design led to much improved operation. The performance of the rods also improved as more experience was gained in the maintenance and adjustment of the various headgear components. Each headgear is now overhauled once a year on a routine basis. The present design of shut-off rod is considered to be very satisfactory. There has only been one occasion when a shut-off rod has failed to come fully down on a trip. Rods failed to operate correctly on five other occasions but these occurred during shutdown periods or when the reactor was being shutdown manually. (auth)

8461 (JUL-266-RE) UNTERSUCHUNG DER ELEKTROMAGNETISCHEN KUPPLUNG DES DIDO (FRJ-2)—GROBSTEUERARMES. (Study of the Electromagnetic Coupling of DIDO (FRJ-2)—Coarse Control). Thamm, G. (Kernforschungsanlage, Juelich (West Germany). Zentralabetilung Forschungsreaktoren). May 1965. 24p. Dep. mn.

The drop delay of the coupling-holding magnet of the coarse control of the FRJ-2 (DIDO) was investigated and the behavior of the electromagnetic coupling in the drop was described. By application of a non-conducting coil (Movotex) the drop delay time could be reduced from 50 msec to approximately 15 msec. The order of magnitude attained for the drop delay can be improved by introduction of air gaps between the coupling head and armature. The investigations showed also that an effective reactor shutdown is possible through an increased initial acceleration of the coupling armature in the drop. (tr-auth)

8462 (NP-15644) NEUTRON FLUENCE MEASUREMENTS IN THE TWELVE INCH DUCT OF THE PULSTAR REACTOR. De Pangher, J.; Pearson, E. B.; Smith, E. A. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). Mar. 4, 1965. 37p.

Efforts directed to achieve accurate neutron fluence measurements in the Pulstar reactor facility are described. The techniques used and the data handling methods are described along with the results of the dosimetry measurements. The net standard error in the reported neutron fluence (for all neutrons with energies greater than 0.1 Mev) was determined to ±30%. (auth)

8463 (ORNL-TM-1070) STABILITY ANALYSIS OF THE MOLTEN-SALT REACTOR EXPERIMENT. Ball, S. J.; Kerlin, T. W. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 79p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A detailed analysis shows that the MSRE is inherently stable. It has sluggish transient response at low power, but this creates no safety or operational problems. The study included analysis of the transient response, frequency response, and pole configuration. The effects of changes in the mathematical model for the system and in the characteristic parameters were studied. A systematic analysis was also made to find the set of parameters, within the estimated uncertainty range of the design values, that gives the least stable condition. The system was found to be inherently stable for this condition, as well as for the design condition. The system stability was underestimated in earlier studies of MSRE transient behavior. This was partly due to the approximate model previously used. The estimates of the values for the system parameters in the earlier studies also led to less stable predictions than current best values. The stability increases as the power level increases and is largely determined by the relative reactivity contributions of the prompt feedback and the delayed feedback. The large heat capacities of system components, low heat transfer coefficients, and fuel circulation cause the delayed reactivity feedback. (auth)

8464 (ORNL-TM-1351) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, JULY, AUGUST, AND SEPTEMBER OF 1965. Tabor, W. H.; Hurt III, S. S. (Oak Ridge National Lab., Tenn.). Nov. 22, 1965. Contract W-7405-eng-26. 35p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The ORR operated 82.8% of the time during the quarter, producing 2269 Mwd of energy. There were 11 shutdowns (all scheduled) four of which ended low-power tests. End-of-cycle shutdowns accounted for 78% of the total downtime.

The absence of unscheduled shutdowns attests to the excellence of the performance of the reactor and experiment instrumentation. Mechanical maintenance problems were routine in nature. The new Radiation-and-Contamination Alarm System was activated after proper operating procedures were approved and issued. Revised evacuation procedures, with special provisions for the control room, were also placed into effect. A core composed of fuel elements that initially contained 240 grams of ^{235}U was loaded. Preliminary data indicate that operation with this type of loading will be satisfactory. Background reactor-noise measurements were made at varying flow rates and power levels. (auth)

8465 (RFX-316) REACTOR PHYSICS MEASUREMENTS IN RO WITH 27-ROD CLUSTERS OF NATURAL UO_2, 1.35 CM IN DIAMETER. Persson, R.; Wikdahl, C.-E. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Sept. 30, 1964. 28p. Dep. mn.

Clusters with three different pin pitches were investigated by means of the substitution technique as regards the material buckling versus lattice pitch and the changes of buckling and diffusion coefficients caused by the introduction of air as "coolant." The buckling change with void is found to be in approximate agreement with that predicted by a modified version of BURNUP-5 calculations, but the radial diffusion coefficient changes less than expected giving rise to a more pronounced anisotropy. The measured changes of the diffusion coefficients can, however, be well correlated by means of a simple formula combining two extreme definitions of the average diffusion coefficient. Activation studies were performed in one lattice configuration on voided and D_2O-filled clusters. The fine structure was measured by means of copper foils and wires. (auth)

8466 (SC-DR-65-530) ION PLATING OF SPRF REACTOR PARTS. Mattox, D. M.; Bland, R. D. (Sandia Corp., Albuquerque, N. Mex.). Nov. 1965. Contract AT (29-1)-789. 16p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

It was found that SPRF reactor parts are protected from corrosion more effectively by an ion-plated coating of aluminum than by an electroplated nickel coating. Extensive detail is given on the technique of ion plating aluminum on the reactor parts and on observations made during plating. Stripping of the aluminum plating from several of the pieces showed the probable existence of an aluminum-uranium intermetallic, interfacial layer formed during the deposition process. Some possible improvements on the plating process are given based on the experience gained in plating these parts. (auth)

8467 SPACE-TIME-BEHAVIOR OF THE NEUTRON FLUX IN LOOSELY COUPLED CORES. Emendoefer, D.; Ramsauer, G.; Siegert, H.-J. (Technische Hochschule, Stuttgart). Atomkernenergie, 10: 429-31(Nov.-Dec. 1965). (In German).

A set of coupled group diffusion equations describing the interaction between loosely coupled cores is derived. Depending on the core, in which they are originated, the neutrons are divided into different species. By weighting with the importance function two-point kinetic equations are obtained from the space and time dependent group diffusion equations. As an application different two-point models are compared with the space and time dependent group diffusion calculation for the two-slab-PTB-reactor. (auth)

8468 ON THE CHANGES OF REACTIVITY BEHAVIOR OF BER. Biersack, J.; Wasserroth, K. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Atomkernenergie, 10: 449-50(Nov.-Dec. 1965). (In German).

The reactivity changes due to uranium burnup and fission product poisoning were calculated by a two-group perturbation theory. The same changes were measured during the reactor operation of the BER characterized by an energy accumulation of 400 Mwh. The theoretical and experimental values for this operation time are in rather good agreement. (auth)

8469 ABSOLUTE MEASUREMENT OF THE FAST NEUTRON FLUX IN THE TRIGA MARK-II REACTOR. Berwanger, G. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 10: 451-9(Nov.-Dec. 1965). (In German).

The energy spectrum of the fast neutron flux in the Triga Mark-II Reactor was measured absolutely in short energy intervals by use of threshold detectors. Some new threshold detectors were tested. Some of them have been prepared for flux measurements. It is shown that there also can be found an effective threshold energy and the corresponding effective cross section for a threshold reaction of which the excitation function is not known completely. The gap in the neutron spectrum between 1 kev and 1 Mev was closed by means of the interpolation method by Genthon. Other methods for flux measurement are described and their usefulness is discussed. (auth)

8470 IRRADIATION CAPSULE WITH CIRCULATING GAS. Ahlf, J.; Melkonian, G. A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomkernenergie, 10: 459-62(Nov.-Dec. 1965). (In German).

An irradiation capsule was constructed wherein specimens are cooled by a gas (He or N_2) circulating in a closed loop. The gas is pumped by a piston compressor via a cooler (-75°C) to the capsule. In a central position of the FRG-1 operating at 5 Mw specimen-temperatures could be maintained being 150 to 200°C below those obtained without forced gas circulation. The dose rate near the out-pile-parts of the irradiation device was below 30 mrem/h. Possibilities of application of this capsule are suggested. (auth)

8471 WR-1: UNIQUE AMONG RESEARCH REACTORS. Can. Nucl. Technol., 4: 30-1; 34(1965).

The design of the WR-1 reactor (organic-cooled, heavy water-moderated, natural uranium-fueled) is described. The design philosophy was to achieve a station layout that would permit WR-1 to be used for various engineering tests involving alternative fuels and fuel channel materials and configurations, as well as a variety of reactor coolants. A fact sheet and design details are presented. (M.C.G.)

8472 AUTOMATIC START-UP OF THE NUCLEAR RESEARCH REACTOR WITH A DIGITAL COMPUTER. Takamatsu, Shigeyuki; Takahashi, Yoshizo (Tokyo Shibaura Electric Co., Ltd.). Genshiryoku Kogyo, 9: 6-14 (Sept. 1963). (In Japanese).

A digital computer is introduced for the automatic start-up of nuclear reactor from its source level. The computer used is a special purpose computer which counts pulse signals of neutron detectors and calculates reactor period according to the formula $T = 2\Delta t\,(n_2 + n_1)/(n_2 - n_1)$, where n_1 and n_2 are numbers of counts for Δt seconds at the time t and $t + 4\Delta t$ respectively. The formula is found to give a more stable period signal than analog period detection system. The calculated period, together with the number of counts, is compared with the preset start-up program in every Δt second and the control signal whose magnitude depends on the period error is produced in the computer. The control signal changes the direction and the speed of the control rods to keep the power growth of the reactor as near the preset program as possible. Three BF_3 counters are used as the neutron detector to measure six decades of the reactor power. After the performance of the equipment had been tested with the reactor simulator, the automatic start-up of the Toshiba Training Reactor from 0.5 Mw up to 500 w was successfully carried out. (auth)

8473 PROBLEMS OF REACTOR STUDIES IN UNIVERSITIES. Oyama, Akira (Tokyo Univ.). Genshiryoku Kogyo, 11: 5-40(Mar. 1965). (In Japanese).

The present state of reactor studies conducted in Japanese universities and colleges is described. In Tokyo University, studies and investigations are in progress, using an experimental subcritical assembly, tandem-type accelerator, dynamitron, ^{60}Co irradiation apparatus, etc.

The research works, conducted in Tokyo Inst. of Technology include reactor physics, reactor engineering, reactor thermal technology, reactor materials, health physics, etc. The Kyoto University research reactor, KUR, a swimming pool type of 1000 kw, was completed in 1964. Details of the reactor and its other facilities are described. Osaka University has an experimental subcritical assembly. The TRIGA II type research reactor in Rikkyo University was completed in 1961; it is operated five periods of time a week and is used for RI production and activation analysis. Tohoku University has an experimental subcritical assembly, Cockcroft-Walton type neutron generator, reactor simulator, mass spectrometer, etc. In Musashi Technical College, a TRIGA II type research reactor was installed in 1963. An outline of the reactor and its other facilities is given. (NSA of Japan)

8474 INSTRUMENTATION AND CONTROLS OF RESEARCH REACTOR JRR-4. **Matsuka, Shigemichi (Hitachi, Ltd., Japan). Hitachi Hyoron, 47: 488-94(Mar. 1965). (In Japanese).**

The swimming-pool type reactor JRR-4 (1000 kw for shielding experiments), completed in Nov. 1964 in JAERI by Hitachi, Ltd., went critical on Jan. 28, 1965. The instrumentation and controls for this reactor are described. The neutron instrumentation consists of the following five channels: the first channel for measuring in the start-up range, the second channel for measuring the reactor period in the intermediate and normal operation ranges, the third and fourth channels for producing electric power signals for the automatic control system, and the fifth channel for measuring the decay of neutrons in the shutdown of the reactor. The process instrumentation consists of 15 thermometers and recorders, 3 pressure gages, 6 flowmeters, 5 liquid level gages, 3 electro-conductivity meters and recorders, and 3 pH meters and recorders. The safety instrumentation consists of interlock devices by means of which the start-up operation system cannot be reset until the causes of the scram have been eliminated, an alarm started by 16 preset cautionary signals, a slow scram started by 14 preset danger signals, a fast scram to drop the safety plates within 400 msec, and a manual back-up scram. The automatic control system with a feedback circuit is so constructed that the precision of the control is ±0.5% offset and the drift of the open loop circuit ±0.2% per 24 hrs. Some problems encountered in the design of the instrumentation and controls are also referred to. (NSA of Japan)

8475 A TIME-OPTIMAL, ON-OFF, PROGRAM FOR THE NRU REACTOR DIGITAL COMPUTER CONTROL EXPERIMENT. **Monta, Kazuo; Lennox, C. G. (Nippon Atomic Industry Group Co., Kanagawa-ken, Japan). J. Nucl. Sci. Technol. (Tokyo), 2: 391-405(Oct. 1965).**

Methods by which flux tilts can be controlled and constant overall power of a high flux research reactor (NRU) can be maintained using digital computer control are described. From coolant water temperature signals, the digital computers detect overall power deviation caused by flux tilts and control the reference setting to the analog neutron-flux control system. First, according to sampled-data control theory and with linear approximation, a control program which is repeated regularly with fixed period is obtained mainly from time domain synthesis. Second, methods for computer time saving are studied, since the computers are time-shared amongst various tasks. One method is to change the constant period of control calculation to being dependent on system error. Actually an On-Off sampling scheme is used for this purpose. The other method is, in addition to the former, to change control calculation itself. A Time Optimal Control is applied to the control program. These control programs were designed, programmed, and then tested for the NRU simulator system. The results showed that considerable computer time was saved by the proposed methods. (auth)

8476 INSTRUMENTATION PARTICULARITIES AT THE RESEARCH AND MEASURING REACTOR OF THE PHYSIKALISCH-TECHNISCHE BUNDESANSTALT. **Schallopp, B. Kerntechnik, 7: 558-64(Dec. 1965). (In German).**

The general instrumentation used for safety, maintenance of operational conditions, experimentals aims, and monitoring are described. The individual instruments considered are a neutron ionization chamber with movable γ compensation, a fission chamber, monitors for the primary cooling circuit, water-level monitors, clamps on the steel tubes, and irradiation devices. (J.S.R.)

WASTE DISPOSAL AND PROCESSING

See also BIOLOGY AND MEDICINE — Ecology
CHEMISTRY — Radiochemistry
CHEMISTRY — Separation Processes and Procedures
HEALTH AND SAFETY

Refer also to abstract 7293.

8477 (BNWL–139) RESEARCH AND DEVELOPMENT ACTIVITIES, FIXATION OF RADIOACTIVE RESIDUES. Quarterly Progress Report, April–June 1965. Platt, A. M. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1965. Contract AT(45-1)-1830. 36p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Samples of phosphate glass produced from Purex waste in the Hot Cell Glass Experiment did not show appreciable change in leachability over a seven-month period since they were made. However, they are showing evidence of separation of a minute second phase. Laboratory studies of glass formulations indicated that the properties of the glass are affected by the precious metal and fission product contents of the glasses. Flowsheet development with simulated NFS 1st and 2nd cycle waste and added phosphoric acid was completed with a successful 40-hr spray calciner run. Metallic cation equivalent to phosphorous atom ratio (M^+/P) equal to 3.1 was the most successful composition. A feed composed of a sulfate-bearing condensate adjusted to melt with caustic was not operable in the spray calciner-melter. Other tests included successful thermal shock cleaning of the calciner wall, an acceptable air vibrator to replace an air hammer, and wire filters. Design verification testing of the pot calciner prototype and its related WSEP hardware was successfully completed. Preliminary fission product release tests were made with 15 g samples of simulated waste material spiked with ^{137}Cs. Release fractions of up to one percent were observed during one hour at temperatures up to 1200°C. The reaction between the molten waste material and the stainless steel containers was briefly studied. Temperatures at Purex waste tanks in infinite arrays with 120-foot center-to-center tank spacings were compared with those for single tanks with no neighbors. A recycle flowsheet to improve cesium product purity was demonstrated. Nominal Na/Cs ratios of 8/1 were reduced to 1/3.4 by use of recycle and increased scrub volumes. (P.C.H.)

8478 (KFK–357) STUDIENGRUPPE FUER TIEFLAGERUNG RADIOAKTIVER ABFAELLE. Jahresbericht, 1964. (Study Group for Deep Storage of Radioactive Waste. Annual Report, 1964). Krause, H.; Ramdohr, H. (Kernforschungszentrum, Karlsruhe (West Germany)). May 1965. 26p. Dep. mn.

Studies on the development of safe and economic methods for the long-term removal of radioactive waste and for the design and construction of an installation for the final collection and processing of radioactive wastes are reported. The basic concepts used in the determination of the requirements for long-term storage of radioactive wastes are reported. Experimental work on the storage of radioactive wastes in salt caverns is described. The economic and safety factors to be considered in the disposal of waste under the sea were also considered. (J.S.R.)

8479 (ORNL–3849, pp 1-42) RADIOACTIVE WASTE DISPOSAL. Parker, F. L. (Oak Ridge National Lab., Tenn.).

Studies of sorption and desorption of iodine on mineral surfaces indicate that some species of iodine, probably I_2, can be actively adsorbed onto such surfaces. The sixth radioactive waste injection of a series was started using a mix containing Kingston fly ash as a substitute for some of the portland cement. After approximately 64,000 gal of waste had been injected, a leak developed in the high-pressure piping in the wellhead cell. The injection well was kept open to determine the bleed-back characteristics of the grout. Preparations are nearly complete for the startup of Project Salt Vault, a demonstration of the disposal of high-level waste solids in salt mines. Operation of the prototype test proved the procedures for measurement of salt flow, temperature, etc., in the demonstration. The field and laboratory work of the cooperative study of the Clinch River was terminated. Sorption tests of three soils from the southeastern United States showed that ion exchange capacity was not the controlling factor in radiocesium sorption by these soils. Desorption with sodium acetate revealed a maximum in the time-desorption relationship, particularly in the subsurface horizons. Solution-dispersion coefficients were measured in Berea sandstone as a function of flow rate. The experimental values of the dispersion coefficients varied as the 1.21 power of the solution velocity. Analysis of the critical pathways of radiation exposure to man resulting from the discharge of radioactive materials to the Clinch River has shown that fish and water consumption are most important. The U. S. Geological Survey cooperated in the preparation of a report on the soils and geology of White Oak Creek Basin. The work of the multiagency steering committee for the Clinch River Study has continued. (J.R.D.)

8480 (TID–22427) WASTE TREATMENT PLANT ACCOUNTING PROCEDURE, APPLICATION. Hoffmann, E.; Van Lint, J-M.; Vande Poel, M. (Societe Belge pour l'Industrie Nucleaire, Brussels). Nov. 1965. Contract 218/US. 37p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Economics of running the Mol treatment plants on behalf of the C.E.N. are reported. All prices are quoted in Belgian francs. Two kinds of figures are quoted. In one table actual figures of the December 1964 monthly running expenses are given. Although the other figures quoted are not considered as actual, they do give a very accurate idea of running expenses averaged over the last five years. (P.C.H.)

8481 (TID–22428) WASTE TREATMENT PLANT MANAGEMENT AND ACCOUNTING PROCEDURE. Hoffmann, E.; Van Lint, J-M.; Vande Poel, M. (Societe Belge pour l'Industrie Nucleaire, Brussels). Nov. 1965. Contract 218/US. 104p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

A waste treatment plant is described together with the way in which its accounting is carried out and yields the information required for efficient running and possible improvements. The information is given to show how a treatment cost is determined and understood. (P.C.H.)

8482 WASTE MANAGEMENT. Blomeke, John O.; Roberts, J. Tom (Oak Ridge National Lab., Tenn.). Ann. Rev. Nucl. Sci., 15: 151-74(1965). (ORNL–P–1169).

A survey is presented of waste management problems associated with the fuel processing requirements of the nuclear power industry, which includes a review of existing techniques, together with the needs and prospects for new methods. (L.B.S.)

8483 DISPOSAL OF HIGH ACTIVITY POWER REACTOR WASTES IN SALT MINES: A CONCEPT AND FIELD SCALE DEMONSTRATION. Bradshaw, R. L.; Blomeke, J. O.; Boegly, W. J. Jr.; Empson, F. M.; Parker, F. L.; Perona, J. J.; Schaffer, W. F. Jr. (Oak Ridge National Lab., Tenn.). Nucl. Struct. Eng., 2: 438-46(Oct. 1965). (ORNL–P–1202).

One of the most important advantages of a natural salt formation as a repository for radioactive wastes is its essential impermeability due to its plastic properties. To prove the feasibility of disposal in salt mines a conceptual design has been developed and a demonstration of the storage concept is being prepared in a 1000 ft deep inactive mine in Lyons, Kansas. Economic studies show that costs for an actual disposal operation would fall well within the range allowable for competitive nuclear power. In the demonstration irradiated fuel assemblies from the Engineering Test Reactor will serve as a source of radiation in lieu of actual solidified wastes. Two radioactive arrays (one in the existing floor to check problems in the use of abandoned mines, and one in a specially excavated area) will each contain 14 assemblies in 7 cans. An electrically heated array will serve as a control. Mine renovations and additions are complete, and initiation of the two-year test is scheduled for late 1965. (auth)

GENERAL AND MISCELLANEOUS

8484 (COO-1198-234) A STUDY OF THE β TO ζ TRANSFORMATION IN AgZn SINGLE CRYSTALS. Merriman, Edmund (Illinois Univ., Urbana). Dec. 1964. Contract AT(11-1)-1198. 64p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Partial transformation of β' phase single crystals of AgZn at 120–135°C produced roughly equiaxed ζ particles up to 400 microns across. An approximate ζ crystal shape was deduced from sections parallel to the $\langle 111 \rangle$ planes, though the actual shape is much more complex. Photomicrographs of ζ crystal sections on $\{111\}$, $\{100\}$, and $\{110\}$ planes showed the $\beta'-\zeta$ interfaces to be consistently aligned with the β' lattice. Four variants were observed, as was expected since each was a single ζ crystal whose c-axis derived from a $\langle 111 \rangle$ direction. A shape deformation was demonstrated on planes transformed from the ζ phase to the β phase. It was concluded that the transformation proceeds by some cooperative motion of atoms. (P.C.H.)

8485 (LF-27) INTESTINAL SPIROCHETES AND DISEASE IN DOGS. Technical Progress Report. Pindak, F. F.; Clapper, W. E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. Dept. of Microbiology). Sept. 1965. Contract AT(29-2)-1013. 17p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Suspensions prepared from fecal samples of beagles were examined by phase microscopy. High numbers of borrelia were consistently found in dogs with diarrhea but seldom in healthy dogs. Other types of spirochetes were randomly distributed in both healthy and diarrhetic dogs. Repeated samplings were necessary to establish the relationship of spirochetes to disease since single specimens were occasionally found to vary from the average in both groups. (auth)

8486 (NYO-3228-5) THE SILVER CHLORIDE-AQUEOUS SOLUTION INTERFACE [Thesis]. Steidel, Charles Archibald (Cornell Univ., Ithaca, N. Y.). Feb. 1966. Contract AT(30-1)-3228. 116p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Extensions were made to the Grimley-Mott theory for the silver halide-solution interface to include lattice impurities and also the molecular condenser. Although, direct evidence of the existence of a space charge in the solid was found, its significance was not found. A new technique of transient potential measurements and qualitatively, the a-c conductance measurements, provided reasonable evidence for the existence and importance of the space charge in the solid; further the isoelectric point for macroscopic silver chloride crystals was found to agree with that observed in colloidal systems. Transient potential measurements also provided direct evidence for the existence of the entire theoretical potential, λ, at the interface, and d-c conductance measurements indicated a correlation between the isoelectric point and the conductance minimum. (P.C.H.)

8487 (ORNL-3694) CONCERNING THE MOMENT PROBLEM [Thesis]. Johnson, G. G. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 42p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

Submitted to Univ. of Tennessee, Knoxville.

By the moment problem for the real number sequence $c_0, c_1, \ldots$ and the interval [0,1], one means the problem of determining a real-valued function ϕ on [0,1] such that $c_n = \int_0^1 j^n \, d\phi$, $n = 0, 1, 2, \ldots$. The integrals involved are ordinary Stieltjes integrals, and j is the function such that $j(x) = x$ for each number x. If each of f and g is a function, then fg denotes the function h so that $h(x) = f(x)g(x)$ for all numbers x for which f(x) and g(x) are defined. If n is a positive integer and f is a function, then f^n is the function h so that $h(x) = [f(x)]^n$ for all x for which f(x) is defined. Using Bernstein polynomials, some results of this problem were obtained. (M.O.W.)

8488 (ORNL-TM-1316) A PROGRAMMING SYSTEM FOR REMOTE CALCULATIONS. Katzan, H. Jr. (Oak Ridge National Lab., Tenn.). Nov. 8, 1965. Contract W-7405-eng-26. 45p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A programming system for performing numerical calculations in a direct-access mode from a remote console is described. Although the system can be effectively used by personnel with a variety of backgrounds, it is designed for the nonprogramming scientist or engineer. The system features a repertoire of easy-to-learn statements, one-mode arithmetic, 3 levels of subscripting, and immediate response to user's commands. (auth)

8489 (SC-DC-65-1826) AIRBORNE PHOTOELECTRIC CORONAL INTENSITY MEASUREMENTS DURING THE MAY 30, 1965 ECLIPSE. Robertson, M. M.; Mattison, M. T. (Sandia Corp., Albuquerque, N. Mex.); Liebenberg, D. H. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Dec. 15, 1965. Contract AT(29-1)-789. 19p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

An airborne coronal experiment was conducted during the solar eclipse of May 30, 1965. The experiment was performed to determine, on a relative and absolute basis, the intensities of the radiation of certain coronal spectral lines and chosen band passes of the continuum in the visible spectrum of the corona. These intensities were determined at different discrete line of sight points in the corona and these points were on radii emanating from the sun's center. (M.O.W.)

8490 (SC-R-65-1004) DIGITIZING PRINTED CIRCUIT LAYOUTS FOR AUTOMATIC ARTWORK GENERATION. Bridegam, A. D. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1965. Contract AT(29-1)-789. 36p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The use is described of a special-purpose coordinate digitizer as a programming machine for printed circuit artwork generation. The method of operations, code generation, and benefits of the system are outlined. (auth)

8491 (SC-RR-65-470) A RECOVERY SYSTEM FOR THE SANDIA HAWK SERIES OF SOUNDING ROCKETS. Johnson, D. W. (Sandia Corp., Albuquerque, N. Mex.). Nov. 1965. Contract AT(29-1)-789. 18p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The development and testing of a recovery system for payloads launched by the Sandia Hawk series of sounding rockets are described. This new recovery system permits retrieval from the sea of payloads weighing up to 150 pounds and is the first system to use the Sandia-developed ram air-inflated flotation device. (auth)

8492 (STI/DOC/11(Vol.3, No.2)) LIST OF BIBLIOGRAPHIES ON NUCLEAR ENERGY. (International Atomic Energy Agency, Vienna (Austria)). Oct. 1965. 30p. IAEA Free.

References (132) on all phases of nuclear energy are given to bibliographies published from approximately 1960 through 1965 or in preparation. The fields covered include: uses of nuclear energy; physics and mathematics; controlled thermonuclear processes; chemistry; biological sciences; health and safety; geology and mining; materials; engineering; reactors; instruments and accelerators; application of isotopes; waste disposal and processing; and allied sciences. Separate author and corporate author indexes are included. (P.C.H.)

8493 (SZS-7(1965)) AERZTLICHE UEBERWACHUNG BERUFLICH STRAHLENEXPONIERTER PERSONEN. (Medical Supervision of Professionally Radiation Exposed Persons). Raube, D.; Rose, W.; Schuettmann, W.; Sitzlack, G.; Thiele, H. MAXIMAL ZULAESSIGNE AKTIVITAET VON ^{85}Kr IN HALBLEITERBAUELEMENTEN UND MAXIMAL ZULAESSIGE LECKMENGEN DIESER ELE-

MENTE. (Maximum Allowable Activity of ^{85}Kr in Semiconductor Building Elements and Maximum Allowable Traces of Other Elements). Hoffmann, R. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). July 1965. 18p. Dep. mn.

I. The chain of responsibility of the medical supervision of persons professionally exposed to radiation is outlined, and pertinent regulations are reported. The medical records that must be kept on exposed persons are discussed. II. The maximum permissible concentrations of ^{85}Kr in semiconductor constituents and the maximum permissible traces of other elements were calculated. The methods of calculation are described. (J.S.R.)

8494 (TID–22449) DIACETAMIDE AS A LIGAND [Thesis]. Shankoff, Theodore A. (Fordham Univ., New York). Oct. 21, 1965. Contract AT(30-1)-906. 111p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Diacetamide was studied as a ligand with metal salts of Groups IA, IIA, and IIB and with divalent transition metal and copper(II) salts. It was found that diacetamide behaves as an unusual liquid owing to its structural capabilities. Discrete complexes of the type MX·2DA were formed between diacetamide and various alkali halides in pellets of excess alkali halides during an infrared study, and these complexes involve bidentate diacetamide coordination through the carbonyl groups and interactions between the N-H group of diacetamide and the anion. The data also show that complex formation occurs only for those halides of less than 63% ionic character and for those with cation-to-anion radius ratios of less than 0.78. Unusually high coordination numbers were found in the Group IIA metal salt-diacetamide complexes, i.e., $Ba(ClO_4)_2 \cdot 5DA$ and $Ca(ClO_4)_2 \cdot 5DA$, (both indicating nine coordination). Diacetamide appears to stabilize previously unstable Copper(II)-lithium double halides of the type Li_2CuX_4 and these double salts probably involve planar halogen coordination to copper(II). Three structural isomers are formed between diacetamide and $CdCl_2$, two between the ligand and $CuCl_2$, and two between the ligand and $Li_2CuCl_2Br_2$. Solid-solid interactions may be used to advantage in the preparation of these complexes since many complexes which could not be isolated from solution were isolated using this technique or variations of it. (P.C.H.)

8495 (UCRL–7950-T) CALCULATION OF VIRIAL COEFFICIENTS. SQUARES AND CUBES WITH ATTRACTIVE FORCES. Hoover, William G.; Ree, Francis H. (Lawrence Radiation Lab., Univ. of California, Livermore). July 7, 1964. Contract W-7405-eng-48. 49p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A general combinatorial formulation of the star integrals occurring in calculations of virial coefficients is presented. The usefulness of the formulation is demonstrated by the exact calculation of the first five virial coefficients for gases of hard parallel squares and cubes with attractive forces. For these gases the three-, four-, and five-term virial series are examined, and each series is found to have a critical point. Most of the critical properties of these truncated virial series are sensitive to the number of terms included, but the product P_cV_c remains nearly constant as more terms are added. It is shown that any two- or three-dimensional square-well virial coefficient is negative at low temperature. Despite this, the low-temperature contribution of the complete star integral can be either positive or negative. (auth)

8496 (UCRL–16265) CALCULATION OF THE INFRARED ACTIVE BENDING DIPOLE DERIVATIVE AND FORCE CONSTANT METHANE [Thesis]. Kortzeborn, Robert N. (Lawrence Radiation Lab., Univ. of California, Berkeley). Nov. 1965. Contract W-7405-eng-48. 89p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The dipole derivative and bending force constant are calculated for an infrared active vibration of methane via the one-center electronic self-consistent-field method. The one-center spherical model Hartree-Fock self-consistent-field analytical electronic wavefunction (OCSMHFSCF) of methane is calculated by retaining only terms of $l = 0$ in the nuclear-electronic potential term of the Hamiltonian. The force constant is calculated with this function by variation-perturbation techniques. An improved non-spherical SCF function containing terms of l up to and including three is then used to recalculate the force constant and dipole derivative. The best calculated force constant is in error by only 2% while the dipole derivative is approximately twice the observed value. This enables the influence of higher symmetry terms on the force constant to be tested, and the usefulness of the dipole derivative and force constant for determining the quality of molecular wavefunctions of this type to be analyzed. (auth)

8497 (JPRS–33152) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 253, DECEMBER 6, 1965. 65p. (TT–65–33728). CFSTI $3.00 cy, $0.75 mn.

Nine articles are included; one being abstracted in NSA. The remaining articles include information on: health programs; power generation by sea waves; electrochemistry of InSb; lasers using Nd^{3+} in $CaWO_4$; guide wave propagation in ferrite cylinders; and rain from warm clouds. (P.C.H.)

For an abstract of the individual paper see: 6920.

8498 ATOMIC ENERGY IN CANADA. Gray, J. L. (Atomic Energy of Canada Ltd., Ottawa). Atomwirtschaft, 10: 557-9(Nov. 1965). (In German).

The atomic energy program of Canada is outlined and compared with the German program. A concentration on the boiling-water reactor is a characteristic of the Canadian program. The organization of the program, the relations of the AECL to private industry, and the units of the atomic program are considered. (J.S.R.)

8499 CENTRAAL LABORATORIUM TNO—DELFT. Staverman, A. J. (Central Lab. TNO, Delft, Netherlands). Chem. Ind. (London), No. 33, 1438-41(Aug. 14, 1965).

The history, organization, and scope of research of this laboratory is surveyed, including investigations in nuclear science. In the department for high-energy radiation, work is being done on the synthesis of labeled molecules, on thickness measurement or other gaging problems with high-energy radiation, and on chemical analysis by x-ray fluorescence and activation methods. (BBB)

8500 ATOMIC HANDBOOK. VOLUME I. EUROPE. Shortall, John W. (ed.). London, Morgan Brothers Ltd., 1965. 858p. 7£; $20.00.

The socio-economic aspects of atomic energy in Europe is considered. Information is presented on budgets and capital investments, manpower, electrical power, research and development facilities, and the historical development of atomic energy programs in 29 countries and 18 international organizations. The names, positions, addresses, and telephone numbers of 4000 people in atomic energy in these countries are provided. Tabulations and summaries are included on international organization membership, agreements for nuclear power cooperation between countries, reactors, high-energy accelerators, and facilities for thermonuclear research. Lists of journals and journalists interested in nuclear energy, nuclear public relation specialists, and nuclear year books and reference books are presented. (M.C.G.)

8501 INDUSTRIAL MANAGEMENT IN THE ATOMIC AGE. Patterns, Restraints, Opportunities, and Trends in Government-Sponsored Technology. Parsegian, V. Lawrence. Reading, Mass., Addison-Wesley, 1965. 384p. $10.75.

The history and multiple aspects of atomic development are reviewed along with the organization of the Atomic Energy Commission. Categories and magnitudes of atomic operations, economics and characteristics of nuclear power, fuel processing cycles, fuel elements and other reactor materials, commercial products for atomic developments, contractural policy and instruments for fiscal control, inventions and patents, dissemination and control of information, guides for safety in atomic activities,

licenses and regulations for nuclear work, and liability, insurance, and indemnity are discussed. The appendixes contain an introduction to nuclear physics, examples of contracts, and a glossary. (M.C.G.)

8502 POLYCELLULAR TUBULAR GRID STRUCTURES AND METHOD OF MANUFACTURE. Davenport, Donald E. (to U. S. Atomic Energy Commission). U. S. Patent 3,222,144. Dec. 7, 1965.

An explosive method of manufacturing tubular grid structures and the resultant products are described. In such a process a bundle of elongated slender rod-like elements is surrounded with a jacket layer of explosive. The explosive is ignited to cause an annular detonation front to progress along the bundle producing a converging shock wave. This shock wave compressed, deforms, and fuses the rod-like elements together with the interfaces defining a polyhedral polycellular matrix. By using a core that may be removed by melting or dissolving in the rod-like elements an open honeycomb results. Other core materials yield a composite body. The advantages of this method include thin walls, small diameter hole honeycomb, and simultaneous shaping and joining even dissimilar materials, which do not ordinarily bond with others. (AEC)

8503 METHOD FOR DETERMINING THE ADHESION OF METAL PLATING. Jacky, Germaine F.; Sorenson, Robert; Shannon, Donald W.; Tragert, William E. (to U. S. Atomic Energy Commission). U. S. Patent 3,223,598. Dec. 14, 1965.

A method was developed for measuring the adherence of a plating of a metal such as nickel, cobalt, iron, platinum, and palladium to a substrate such as aluminum, chromium, molybdenum, tungsten, and magnesium. Hydrogen was electrolytically generated on the surface of the plating in an electrolytic cell having the metal plated piece as its cathode by passing a predetermined constant total amount of d-c electricity between the anode and the cathode of the cell, and quantitatively measuring the amount of blistering of the plating. (AEC)

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This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä	becomes	ae
ö		oe
ø		oe
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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is identifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included in cumulative indexes to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Gland and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings, e.g., Amino Acids rather than Acids, Amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases parenthetic modifying terms or inverted headings of the form Neutrons, Fast are used in preference to a direct entry that would result in the scattering of information. Organic compounds are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of Chemical Abstracts, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are alphabetized word-by-word. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out.

Examples:

M-Capture
see Electron Capture
Magnesium
Magnesium Alloys
Manganese Fluorides
Manganese(II) Fluorides
Mesons
Mesons (π)
Mesons (ρ)
3-Pentanol, 2,4-Dimethyl-
2-Pentanol, 2-Methyl-
2-Pentanol, 4-Methyl-

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Alloys and Other Systems

Multicomponent alloys, except well-known trade names, are indexed under a main heading in the form "element alloy" for each element in the alloy. The modifier begins with element symbols for each component arranged alphabetically as if the English name for the element were spelled out.

Example: Copper-Gold Alloy is indexed
Copper Alloys
Cu-Au...
Gold Alloys
Cu-Au...

Well-known alloys such as Zircaloy-2 are indexed directly to the trade name; cross references referring from each component of the alloy to the entry for the trade name appear in cumulative indexes.

Multicomponent systems of non-metallic elements are indexed in a manner similar to alloys except the main heading used contains the word "Systems" in place of "Alloys."

Example: Silicon–Tungsten Systems are indexed
Silicon Systems
Si-W...
Tungsten Systems
Si-W...

Multicompound systems and mixtures of compounds are indexed under the main heading for each component com-

pound; the modifiers begin with an alphabetical listing of compound formulas.

Example: Lead Titanate–Lead Zirconate is indexed

Lead Titanates
$PbTiO_3$-$PbZrO_3$...
Lead Zirconates
$PbTiO_3$-$PbZrO_3$...

A mixed system of compounds and elements is indexed using a combined form of the above conventions, e.g., a dispersion of copper and alumina would be indexed

Aluminum Oxides
Al_2O_3-Cu...
Copper Systems
Al_2O_3-Cu..

Physical States and Configurations of Materials

Specification of the physical state, if other than normal, or geometric configuration of the material is included in the modifying phrase, i.e., liquid metals would be indexed to the metal with "liquid" in the modifier, and carbon crucibles would be indexed to Carbon with "crucibles" appropriately placed in the modifier and also to Crucibles if appropriate.

Modifying Phrases

The modifiers appearing under a main heading are written specifically to describe the relation of the item being indexed to that main heading. The modifier, therefore, will generally contain more useful information about that relation than will a title or a phrase written to be used under every main heading assigned to the item. Effort is exerted to begin the modifier with the word judged to be of greatest use to the greatest number of users; this, however, does not obviate the need to consider all modifiers under the main heading(s) of interest.

Modifiers are usually intended to form a meaningful phrase when combined with the main heading. Some are intended to be read following the main heading, e.g., the entry Hydrogen—sorption by charcoal is read "hydrogen sorption by charcoal"; however, as a result of placing the important word first, many modifiers must be arranged for smooth reading, e.g., Formaldehyde—yields in radiolysis of ethyl ether, effects of deuterium on is read "effects of deuterium on formaldehyde yields in radiolysis of ethyl ether" and Uranium—crystal structure of, effect of cooling rate on allotropic transformations in is read "effect of cooling rate on allotropic transformations in crystal structure of uranium." Prepositions are sometimes omitted if no ambiguity results.

Special characters are added to modifiers in the field of physics; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the journal reference number. The value of this identification has been established by the American Institute of Physics.

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UN	United Nations Bookshop, United Nations Headquarters, New York, New York.
USGS	Available free of charge from the U. S. Geological Survey, Washington, D. C. 20242.

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Report No.	Abstract No.	Availability
AAEC-E–	**(Australian)**	
138	20-7549	Dep. mn
AAEC-TM–	**(Australian)**	
294	20-6998	Dep. mn
AD–	**(Misc.)**	
620856	20-7248	CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf
620967	20-6789	CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf
620996	20-7979	CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf
622945	20-7775	CFSTI $2.00 cy, $0.50 mn
624736	20-7776	CFSTI $1.00 cy
624917	20-6769	CFSTI $2.00 cy, $0.50 mn
AE–	**(Non-AEC)**	
63-0011	20-8438	
AEC-tr–	**(For complete listing see TID-4025)**	
6660	20-7680	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf
6662	20-7803	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf
6664	20-7681	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf
AECL–	**(Canadian)**	
2275	20-7550	Dep.; AECL $0.50
2295	20-7293	Dep.; AECL $0.20
2299	20-8460	See IOI-296
2508	20-7478	Dep.; AECL $0.50
AED-C–	**(Non-AEC)**	
04-20	20-6770	Dep. mn
10-04	20-6924	Dep. mn
AEET–	**(Indian)**	
216	20-7184	Dep. mn
224	20-7185	Dep. mn
225	20-6999	Dep. mn
AEET-HP–	**(Indian)**	
Environ/4	20-7294	Dep. mn
AERE-M–	**(British)**	
1483	20-7000	Dep. mn
1489	20-7486	Dep. mn
1641	20-7354	Dep.; BIS $0.60; HMSO 3s.
AERE-NP–	**(British)**	
GEN/26	20-7355	Dep. mn
AERE-R–	**(British)**	
3880	20-7295	Dep. mn
4155	20-7456	pp 52-64 of Radioactivity in Man. George R. Menely; Shirley Motter Linde (eds.). Springfield, Ill., Charles C Thomas, 1965.
4556	20-7337	Dep.
5087	20-8321	Dep.
AI-Trans–		
203	20-8045	Dep. mn; JCL $1.10 fs, $0.80 mf
AH–	**(Misc.)**	
1443	20-8042	See TID-22446
1447	20-8043	See TID-22447
ANL–		
6865	20-8376	Dep. mn; CFSTI $3.00 cy, $0.75 mn
7023	20-8343	Dep. mn; CFSTI $4.00 cy, $0.75 mn
7041	20-8344	Dep. mn; CFSTI $5.00 cy, $1.00 mn
7063	20-7959	Dep. mn; CFSTI $3.00 cy, $0.75 mn
7086	20-7047	Dep. mn; CFSTI $2.00 cy, $0.50 mn
7089	20-7240	Dep. mn; CFSTI $2.00 cy, $0.50 mn
7095	20-8060	Dep. mn; CFSTI $1.00 cy, $0.50 mn
ANL-Trans–		
242	20-8088	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf
251	20-7585	Dep. mn; JCL $2.60 fs, $1.10 mf
APDA–	**(Misc.)**	
179	20-8322	Dep. mn; CFSTI $2.00 cy, $0.50 mn
ARL–	**(Non-AEC)**	
65-202	20-8179	CFSTI $1.00 cy
ASTRO MET–	**(Non-AEC)**	
9-1-0032	20-7536	See N65-25276
BAW–	**(Misc.)**	
66	20-8345	
291	20-7487	Dep. mn; CFSTI $1.00 cy, $0.50 mn
BDX–		
613-77	20-7551	Dep. mn; CFSTI $2.00 cy, $0.50 mn
BLG–	**(Belgian)**	
205	20-8377	Dep. mn
BMI–	**(Misc.)**	
1742(Del.)	20-7488	Dep. mn; CFSTI $0.75 cy, $0.50 mn
1745	20-7489	Dep. mn; CFSTI $0.75 cy, $0.50 mn
1748(Del.)	20-7493	Dep. mn; CFSTI $2.00 cy, $0.50 mn
BMI-X–		
10146	20-7628	Dep. mn; CFSTI $1.00 cy, $0.50 mn
BNL–		
953	20-7494	Dep. mn; CFSTI $3.00 cy, $0.50 mn
8562	20-6821	Ecology, 46: 517-20(1965)
8984	20-7539	Nucl. Appl., 1: 405-11(1965)
9042	20-7145	J. Amer. Chem. Soc., 87: 5301-8(1965)
9069	20-7131	Ann. Rev. Nucl. Sci., 15: 89-124(1965)
9157	20-7462	Nucl. Instrum. Methods, 37: 1-8(1965)
9540	20-8124	Phys. Lett., 19: 397-8(1965)
9653	20-6771	Dep. mn; CFSTI $1.00 cy, $0.50 mn
9654	20-8455	Dep. mn; CFSTI $1.00 cy, $0.50 mn
9663	20-7669	Dep. mn; CFSTI $1.00 cy, $0.50 mn
9671	20-6925	Dep. mn; CFSTI $1.00 cy, $0.50 mn
9698	20-7296	Dep. mn; CFSTI $2.00 cy, $0.50 mn
9722	20-7356	Dep. mn; CFSTI $1.00 cy, $0.50 mn
9726	20-6926	Dep. mn; CFSTI $1.00 cy, $0.50 mn
9729	20-7357	Dep. mn; CFSTI $1.00 cy, $0.50 mn
9755	20-6717	Dep. mn; CFSTI $1.00 cy, $0.50 mn
BNL-tr–		
4	20-8288	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf
17	20-7371	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf
26	20-7233	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf
30	20-8089	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf
BNWL–		
139	20-8477	Dep. mn; CFSTI $2.00 cy, $0.50 mn
148	20-7338	Dep. mn; CFSTI $1.00 cy, $0.50 mn
150	20-7495	Dep. mn; CFSTI $4.00 cy, $1.00 mn
153	20-7630	Dep. mn; CFSTI $1.00 cy, $0.50 mn
165	20-7297	Dep. mn; CFSTI $2.00 cy, $0.50 mn
BNWL-SA–		
332	20-7631	Dep. mn; CFSTI $1.00 cy, $0.50 mn
380	20-7552	Dep. mn; CFSTI $1.00 cy, $0.50 mn
382	20-7553	Dep. mn; CFSTI $1.00 cy, $0.50 mn
385	20-7554	Dep. mn; CFSTI $1.00 cy, $0.50 mn
409	20-8456	Dep. mn; CFSTI $1.00 cy, $0.50 mn
410	20-7001	Dep. mn; CFSTI $1.00 cy, $0.50 mn
413	20-7533	Dep. mn; CFSTI $1.00 cy, $0.50 mn
415	20-7498	Dep. mn; CFSTI $1.00 cy, $0.50 mn
BRLD–	**(Non-AEC)**	
2946	20-8442	See NASA-CR-54758
3133	20-8443	See NASA-CR-54776
CALT–		
68-54	20-7866	Phys. Rev. Lett., 15: 986-9(1965)
CAPE–		

Report No.	Abstract No.	Availability
1241	20-7453	
1262	20-8271	
1274	20-7452	
CCDN-CI-2(Suppl.1)	20-8077	See NYO-72-52(Suppl.1)
CEA-R-2631	(French) 20-8061	Dep. mn
CEA-tr-R-1850	(French) 20-7324	Dep. mn; JCL $2.60 fs, $0.95 mf
CEX-59.7B(Pt.3)	20-7298	Dep. mn; CFSTI $1.00 cy, $0.75 mn
CNAEM-29	(Turkish) 20-7992	Dep. mn
CONF-362	20-6986	(2nd Symposium on Radiochemistry in Man, Chicago, Sept. 1962)
CONF-384–	(Symposium on Radioactivation Analysis and Its Application to the Biological Sciences, Saclay, France, Sept. 1963)	
3	20-7046	ORINS
CONF-654	19-2907 19-6030	(American Nuclear Society Meeting, San Francisco, Nov. 30–Dec. 3, 1964) Proceedings
99	20-8401	See WAPD-T-1732(Rev.)
CONF-620406	20-7991	(2nd Symposium on the Plasma Sheath, Boston, Apr. 10–12, 1962)
CONF-620803	20-7045	(3rd International Symposium on X-Ray Optics and X-Ray Microanalysis, Stanford, Calif., Aug. 22–24, 1962)
CONF-620909 (Pts. I & II)	20-7717	(13th International Astronautical Congress, Varna, Bulgaria, Sept. 1962)
CONF-630302	20-7182	(Symposium on Elementary Processes in High-Energy Chemistry, Moscow, Mar. 18–22, 1963)
CONF-630505	20-6755	(Symposium on the Use of Radioactive Isotopes in Tuberculosis Research, Prague, May 14–17, 1963)
CONF-640711–	(27th Portugo-Spanish Conference on Progress in Sciences, Bilbao, Spain, July 20–24, 1964)	
2	20-7126	See LFEN-27
CONF-650303	20-7625	(3rd Symposium on Thermophysical Properties, Lafayette, Ind., Mar. 22–26, 1965)
CONF-650501	19-47907	(The Application of Computing Methods to Reactor Problems, Argonne, Ill., May 17–19, 1965) See ANL-7050
18	20-8059	ORINS. Gmelin, AED-CONF-65-115-12
CONF-650559	19-47991	(American Institute of Chemical Engineers, 56th National Meeting, San Francisco, Calif., May 16–19, 1965) See GA-6126
8	20-7555	Dep. mn; CFSTI $2.00 cy, $0.50 mn
CONF-650560–	(13th Annual Meeting of the Radiation Research Society, Philadelphia, May 23–26, 1965)	
8	20-6903	ORINS. Gmelin, AED-CONF-65-157-2
9	20-6899	ORINS. Gmelin, AED-CONF-65-157-1
10	20-6919	ORINS. Gmelin, AED-CONF-65-157-16
11	20-6900	ORINS. Gmelin, AED-CONF-65-157-21
CONF-650616–	(Health Physics Society, Annual Meeting, Los Angeles, June 14–17, 1965)	
11	20-6901	ORINS. Gmelin, AED-CONF-65-153-19
13	20-6902	ORINS. Gmelin, AED-CONF-65-153-22
CONF-650647–	(Society of Nuclear Medicine, 12th Annual Meeting, Bal Harbour, Fla., June 19, 1965)	
2	20-6997	ORINS. Gmelin, AED-CONF-65-197-1
CONF-650652–	(International C-14 and H-3 Dating Conference, Pullman, Wash., June 7–11, 1965)	
11	20-7289	ORINS. Gmelin, AED-CONF-65-158-17
16	20-7290	ORINS. Gmelin, AED-CONF-65-158-19
CONF-650802–	(Cryogenic Engineering Conference, Houston, Tex., Aug. 23–25, 1965)	
9	20-7119	ORINS. Gmelin, AED-CONF-65-193-1
CONF-650803–	(IAEA Symposium on Nuclear Materials Management, Vienna, Aug. 30–Sept. 3, 1965)	
11	20-7043	ORINS
20	20-7042	ORINS
34	20-7044	ORINS
CONF-650823–	(International Symposium on the Biochemistry and Physiology of Connective Tissue, Lyon, France, Aug. 31–Sept. 3, 1965)	
2	20-6717	See BNL-9755
CONF-650824–	(Symposium on Liquid Helium, St. Andrews, Scotland, Aug. 26–28, 1965)	
2	20-8002	See COO-1198-299
CONF-650949–	(International Conference on Fracture, Sendai, Japan, Sept. 12, 1965)	
1	20-7583	See UCRL-16326
2	20-7584	See UCRL-16363
CONF-650951–	(International Luminescence Symposium on the Physics and Chemistry of Scintillators, Munich, Sept. 4–10, 1965)	
1	20-8287	See ORNL-P-1701
CONF-650952–	(4th International Conference on X-Ray Optics and Microanalysis, Paris, Sept. 7–10, 1965)	
1	20-7009	See NLCO-960
CONF-650954–	(Ground Water Recharge, Development and Management Biennial Conference, Los Angeles, Sept. 1–2, 1965)	
1	20-7222	See UCRL-14451
CONF-650955–	(American Inst. of Aeronautics and Astronautics, Thermophysics Specialist Conference, Monterey, Calif., Sept. 13–15, 1965)	
1	20-7654	ORINS
2	20-7653	ORINS
4	20-7655	ORINS
5	20-8454	ORINS
CONF-650956–	(Conference on Lattice Defects, Honolulu, Hawaii, Sept. 1965)	
1	20-7582	See UCRL-16271
CONF-650957–	(American Inst. of Metallurgical Engineers, San Francisco, Sept. 9, 1965)	
1	20-7502	See UCRL-16393
CONF-651003–	(4th Symposium on Detonation, Silver Spring, Md., Oct. 13–15, 1965)	
8	20-7960	See LA-DC-7462
CONF-651008–	(Annual Bio-Assay Meeting, Albuquerque, N. Mex., Oct. 7–8, 1965)	
5	20-6724	See ORNL-P-1830
6	20-6725	See ORNL-P-1836
CONF-651009–	(Conference on Safety, Fuels and Core Design in Large Fast Power Reactors, Argonne, Oct. 11–14, 1965)	
9	20-8391	See LA-DC-7336
CONF-651021–	(25th National Convention of the Society for Nondestructive Testing, Detroit, Oct. 18–22, 1965)	
2	20-7242	See LA-DC-6977
CONF-651029–	(15th Annual National Lead Co. Analytical and Physical Testing Symposium, Hightstown, N. J., Oct. 14–15, 1965)	

Report No.	Abstract No.	Availability
1	20-7010	See NLCO-963
3	20-7011	See NLCO-964
CONF-651032–	**(Flow Instability Conference, Schenectady, N. Y., Oct. 21, 1965)**	
1	20-8323	Dep. mn; CFSTI $3.00 cy, $0.50 mn
CONF-651035–	**(Symposium on Advances in Dynamic Radioactive Scanning, Pittsburgh, Oct. 21–22, 1965)**	
1	20-6925	See BNL-9671
CONF-651036–	**(American Society of Civil Engineers, Environmental Engineering Conference and Annual Convention, Kansas City, Kan., Oct. 18–22, 1965)**	
1	20-8451	ORINS
CONF-651037–	**(American Industrial Hygiene Assn., Rocky Mountain Section, Albuquerque, N. Mex., Oct. 22–23, 1965)**	
1	20-7322	See SC-DC-65-1790
CONF-651038–	**(International Conference on Murine Leukemia, Philadelphia, Oct. 13–15, 1965)**	
1	20-6788	See ORNL-P-1703
CONF-651040–	**(IAEA Panel on In-Pile Neutron Fluence Measurements, Vienna, Oct. 11–15, 1965)**	
1	20-7631	See BNWL-SA-332
CONF-651043–	**(Weak Interactions Conference, Argonne, Ill., Oct. 25–27, 1965)**	
3	20-7802	See UCRL-16473
CONF-651044–	**(Conference on Programming for Flying Spot Devices, New York, Oct. 24–26, 1965)**	
2	20-7357	See BNL-9729
3	20-7356	See BNL-9722
CONF-651101	**20-3647**	**(American Nuclear Society, Winter Meeting, Washington, D. C., Nov. 15–18, 1965) (Revised 11-8-65)**
44	20-8313	Dep. mn; CFSTI $2.00 cy, $0.50 mn
47	20-8400	See ORNL-P-1784
48	20-7674	See LA-DC-7318
CONF-651102–	**(Royal Commonwealth Society, 3rd International Conference on Plutonium, London, Nov. 22–26, 1965)**	
11	20-7581	See UCRL-14489
12	20-7550	See AECL-2275
13	20-7567	See LA-DC-7278(Suppl.)
14	20-7568	See LA-DC-7545
CONF-651109–	**(1st Symposium on Accelerator Radiation Dosimetry and Experience, Upton, N. Y., Nov. 3–5, 1965)**	
11	20-7669	See BNL-9663
14	20-7366	See LA-DC-7323A
CONF-651110–	**(American Society of Mechanical Engineers, Annual Winter Meeting, Chicago, Nov. 7–11, 1965)**	
2	20-7232	See WCAP-5480
20	20-8434	ORINS
21	20-8453	ORINS
23	20-8436	ORINS
24	20-8452	ORINS
25	20-8435	ORINS
CONF-651115–	**(Eastern Analytical Symposium, New York, Nov. 18, 1965)**	
1	20-7012	See NLCO-969
CONF-651116–	**(Symposium on Topics in the Biology of Aging, La Jolla, Calif., Nov. 4–6, 1965)**	
1	20-6771	See BNL-9653
CONF-651117–	**(IAEA Study Group on Irradiation Techniques at Research Reactors, Istanbul, Nov. 15–19, 1965)**	
1	20-8455	See BNL-9654
CONF-651118–	**(American Physical Society, Gatlinburg, Tenn., Nov. 11–13, 1965)**	
1	20-8080	See ORNL-P-1700
3	20-8081	See ORNL-P-1786
4	20-8082	See ORNL-P-1793

Report No.	Abstract No.	Availability
CONF-651119–	**(Libby Cockcroft Information Exchange Meeting, Harwell, England, Nov. 8–12, 1965)**	
1	20-7001	See BNWL-SA-410
2	20-7533	See BNWL-SA-413
3	20-8456	See BNWL-SA-409
4	20-7552	See BNWL-SA-380
5	20-7498	See BNWL-SA-415
6	20-7553	See BNWL-SA-382
7	20-7554	See BNWL-SA-385
CONF-651120–	**(15th Hahnemann Symposium, Philadelphia, Nov. 22–24, 1965)**	
1	20-6926	See BNL-9726
COO–		
30-105	20-7859	Phys. Rev. Lett., 15: 805-7(1965)
35-77	20-7729	Phys. Rev., 140: A1481-7(1965)
78-134	20-6807	Arch. Pathol., 80: 641-6(1965)
720-058	20-8062	Dep. mn; CFSTI $3.00 cy, $0.75 mn
878-13	20-6823	Exp. Cell. Res., 40: 104-11(1965)
1198-213	20-8295	J. Phys. Soc. Jap., 20: 1888-94(1965)
1198-234	20-8484	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1198-299	20-8002	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1213-27	20-8326	Dep. mn; CFSTI $5.00 cy, $1.00 mn
1477-2	20-7241	Dep. mn; CFSTI $1.00 cy, $0.50 mn
CU–	**(Misc.)**	
1019-48	20-8120	Phys. Lett., 19: 389-91(1965)
CVNA–	**(Misc.)**	
244	20-8378	Dep. mn; CFSTI $2.00 cy, $0.50 mn
245	20-8379	Dep. mn; CFSTI $3.00 cy, $0.75 mn
246	20-8380	Dep. mn; CFSTI $3.00 cy, $0.75 mn
247	20-8381	Dep. mn; CFSTI $2.00 cy, $0.50 mn
D–	**(Misc.)**	
910093-19	20-7247	CFSTI
DC–	**(Misc.)**	
60-4-179	20-7514	Dep. mn; CFSTI $4.00 cy, $0.75 mn
DESY–	**(German)**	
65/6	20-8272	Dep. mn
65/8	20-8063	Dep. mn
DP–		
1002	20-8371	Dep. mn; CFSTI $2.00 cy, $0.50 mn
DRI–	**(Misc.)**	
1092-219	20-7556	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1092-225	20-7559	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1092-220	20-7557	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1092-221	20-7558	Dep. mn; CFSTI $1.00 cy, $0.50 mn
2274	20-7557	See DRI-1092-220
2276	20-7558	See DRI-1092-221
2482	20-7556	See DRI-1092-219
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EANDC–	**(European-American Nuclear Data Committee)**	
49(U)(Suppl.1)	20-8077	See NYO-72-52(Suppl.1)
ECOM–	**(Non-AEC)**	
2626	20-7339	CFSTI $1.00 cy, $0.50 mn
EGCR–		
4(Suppl.1)	20-7299	Dep.; CFSTI $1.00 cy, $0.50 mn
EGG–		
1183-2057	20-7358	Dep. mn; CFSTI $1.00 cy, $0.50 mn
EUR–	**(European Atomic Energy Community)**	
2088.f	20-7188	Dep. mn
2315	20-7189	See EURAEC-1339
2355	20-7190	See EURAEC-1396
2381	20-8382	See EURAEC-1447
2388	20-7560	See EURAEC-1461
2457.f	20-6772	Dep. mn
2477.f(Vol.1)	20-6905	Dep. mn
2485.e	20-6906	Dep. mn
2510.d	20-6773	Dep. mn

Report No.	Abstract No.	Availability
2511.e	20-6907	Dep. mn
2532.e	20-8346	Dep. mn
2551.e	20-8457	Dep. mn
2553.e	20-8458	Dep. mn
2579.f	20-7300	Dep. mn
2580.e	20-7359	Dep. mn
2654	20-8327	See EURAEC-1487
2656	20-7561	See EURAEC-1489
EURAEC–		
1208	20-7534	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1283	20-7227	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1339	20-7189	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1396	20-7190	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1447	20-8382	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1461	20-7560	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1487	20-8327	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1489	20-7561	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1525	20-7228	See GEAP-4963
1527	20-7628	See BMI-X-10146
1528	20-8387	See GEAP-4954
FD–	**(Non-AEC)**	
32	20-7467	See NP-15658
FTD-TT–	**(Non-AEC)**	
64-910	20-6789	For translation see AD-620967
65-207	20-7979	For translation see AD-620996
65-498	20-7248	For translation see AD-620856
GA–	**(Misc.)**	
5316	20-8314	Dep. mn; CFSTI $3.00 cy, $0.50 mn
5798	20-8035	Dep. mn; CFSTI $6.00 cy, $1.25 mn
6014	20-8383	Dep. mn; CFSTI $2.00 cy, $0.50 mn
6510	20-8384	Dep. mn; CFSTI $2.00 cy, $0.50 mn
6612	20-8347	Dep. mn; CFSTI $6.00 cy, $1.25 mn
6649	20-8385	Dep. mn; CFSTI $3.00 cy, $0.75 mn
6679	20-7632	Dep. mn; CFSTI $1.00 cy, $0.50 mn
6697	20-7246	Dep. mn; CFSTI $2.00 cy, $0.50 mn
6712	20-7785	Dep. mn; CFSTI $1.00 cy, $0.50 mn
GEAP–	**(Misc.)**	
4841	20-8386	Dep. mn; CFSTI $2.00 cy, $0.50 mn
4954	20-8387	Dep. mn; CFSTI $3.00 cy, $0.75 mn
4963	20-7228	Dep. mn; CFSTI $2.00 cy, $0.75 mn
GEMP–	**(Misc.)**	
53A	20-7499	Dep. mn; CFSTI $3.00 cy, $0.75 mn
388	20-8064	Dep. mn; CFSTI $5.00 cy, $1.00 mn
HW–		
61799	20-7515	CFSTI $1.00 cy
I–	**(Misc.)**	
A2049-25	20-7223	See TID-22477
A2412-5	20-7313	See NYO-2539-4
IA–	**(Non-AEC)**	
1057	20-8388	Dep. mn
IAE–	**(Non-AEC)**	
912	20-8180	Dep. mn
933	20-7657	Dep. mn
IBJ–	**(Polish)**	
See INR		
IC–	**(Misc.)**	
65/67	20-7885	Dep. mn
IDO–		
14643	20-7191	Dep. mn; CFSTI $3.00 cy, $0.75 mn
17036	20-8459	Dep. mn; CFSTI $4.00 cy, $0.75 mn
17096	20-8315	Dep. mn; CFSTI $3.00 cy, $0.50 mn
17122	20-7360	Dep. mn; CFSTI $1.00 cy, $0.50 mn
IFJ–	**(Polish)**	
See INP		
INFN-TC–	**(Italian)**	
64/5	20-7670	Dep. mn

Report No.	Abstract No.	Availability
INP–	**(Polish)**	
426/PL	20-8065	Dep.
INR–	**(Non-AEC)**	
594/IA/PL	20-7361	Dep. mn
609/XIX/D	20-7002	Dep.
618/XV/I	20-8066	Dep. mn
629/IA/PL	20-7340	Dep.
634/V/C	20-7003	Dep. mn
637/IX-A/R	20-8036	Dep.
638/I/PL	20-7362	Dep.
650/VI/PH	20-7786	Dep.
652/IA/PL	20-7363	Dep.
INSJ–	**(Japanese)**	
88	20-8067	Dep. mn
IOI–	**(Canadian)**	
296	20-8460	Dep.; AECL $1.00
IS–		
1129	20-7586	Acta Crystallogr., 19: 1019-24(1965)
1132	20-7208	J. Nucl. Sci. Technol. (Tokyo), 2: 410-15(1965)
1181	20-7562	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1224	20-7858	Phys. Rev. Lett., 15: 803-5(1965)
1279	20-7479	Dep. mn; CFSTI $3.00 cy, $0.50 mn
1280	20-7480	Dep. mn; CFSTI $3.00 cy, $0.75 mn
IS-T–		
30	20-7048	Dep. mn; CFSTI $2.00 cy, $0.50 mn
42	20-7004	Dep. mn; CFSTI $3.00 cy, $0.50 mn
48	20-7535	Dep. mn; CFSTI $4.00 cy, $0.75 mn
49	20-8284	Dep. mn; CFSTI $4.00 cy, $0.75 mn
50	20-7049	Dep. mn; CFSTI $2.00 cy, $0.50 mn
51	20-7005	Dep. mn; CFSTI $3.00 cy, $0.75 mn
55	20-7563	Dep. mn; CFSTI $3.00 cy, $0.50 mn
56	20-7564	Dep. mn; CFSTI $3.00 cy, $0.75 mn
59	20-7565	Dep. mn; CFSTI $2.00 cy, $0.50 mn
JINR–	**(Russian)**	
D-2427	20-8068	Dep. mn
E-2413	20-7787	Dep. mn
E-2440	20-7788	Dep. mn
P-2307	20-7993	Dep. mn
P-2311	20-7886	Dep. mn
P-2349	20-7789	Dep. mn
P-2381	20-7790	Dep. mn
P-2382	20-7791	Dep. mn
P-2383	20-8069	Dep. mn
P-2387	20-7671	Dep. mn
P-2391	20-8348	Dep. mn
P-2392	20-7887	Dep. mn
P-2393	20-7792	Dep. mn
P-2396	20-7658	Dep. mn
P-2397	20-7793	Dep. mn
P-2399	20-7794	Dep. mn
P-2400	20-7795	Dep. mn
P-2407	20-7796	Dep. mn
P-2408	20-7672	Dep. mn
P-2415	20-8037	Dep. mn
P-2418	20-7888	Dep. mn
P-2420	20-7364	Dep. mn
P-2421	20-7994	Dep. mn
P-2422	20-7995	Dep. mn
P-2423	20-8070	Dep. mn
P-2424	20-7673	Dep. mn
P-2435	20-8071	Dep. mn
P-2439	20-7797	Dep. mn
P-2441	20-8072	Dep. mn
JPRS–	**(Non-AEC)**	
33039	20-6790	CFSTI $1.00 cy, $0.50 mn
33152	20-8497	CFSTI $3.00 cy, $0.75 mn
33170	20-6792	CFSTI $6.00 cy, $1.50 mn
JUL–	**(German)**	
262-TP	20-7777	Dep. mn
266-RE	20-8461	Dep. mn

Report No.	Abstract No.	Availability
K–		
1649	20-7192	Dep. mn; CFSTI $4.00 cy, $0.75 mn
K-Trans–		
8	20-7343	Dep. mn; JCL $1.10 fs, $0.80 mf
KAPL–		
3027	20-7229	Dep. mn; CFSTI $2.00 cy, $0.50 mn
3095	20-8038	Dep. mn; CFSTI $3.00 cy, $0.50 mn
KFK–	**(German)**	
299	20-8389	Dep. mn
321	20-8073	Dep. mn
329	20-7718	Dep. mn
341	20-7050	Dep. mn
342	20-7365	Dep. mn
352	20-8074	Dep. mn
357	20-8478	Dep. mn
KN–	**(Non-AEC)**	
65-140(R)	20-7006	
65-186	20-7007	
KR–	**(Norwegian)**	
97	20-8439	Dep. mn
99	20-7566	Dep. mn
LA–		
3240	20-8328	Dep. mn; CFSTI $2.00 cy, $0.50 mn
3298	20-6718	Dep. mn; CFSTI $2.00 cy, $0.50 mn
3354	20-8285	Dep. mn; CFSTI $3.00 cy, $0.75 mn
3373	20-8039	Dep. mn; CFSTI $4.00 cy, $1.00 mn
3382	20-7301	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3386	20-7481	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3401	20-8273	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3431	20-8390	Dep. mn; CFSTI $3.00 cy, $0.75 mn
3434	20-8181	Dep. mn; CFSTI $3.00 cy, $0.75 mn
LA-DC–		
6977	20-7242	Dep. mn; CFSTI $1.00 cy, $0.50 mn
7278(Suppl.)	20-7567	Dep. mn; CFSTI $1.00 cy, $0.50 mn
7318	20-7674	Dep. mn; CFSTI $1.00 cy, $0.50 mn
7323A	20-7366	Dep. mn; CFSTI $1.00 cy, $0.50 mn
7336	20-8391	Dep. mn; CFSTI $2.00 cy, $0.50 mn
7462	20-7960	Dep. mn; CFSTI $2.00 cy, $0.50 mn
7492	20-8135	Phys. Rev. Lett., 15: 796-8(1965)
7545	20-7568	Dep. mn; CFSTI $1.00 cy, $0.50 mn
LA-tr–		
65-24	20-7019	Dep. mn; JCL $1.10 fs, $0.80 mf
65-26	20-8185	Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $2.60 fs, $0.83 mf
LADC–		
6208	20-8260	pp 359-97 of Plasma Diagnostic Techniques. New York; London, Academic Press, 1965.
LF–		
27	20-8485	Dep. mn; CFSTI $1.00 cy, $0.50 mn
LFEN–	**(Portuguese)**	
27	20-7126	Dep. mn
LNF–	**(Italian)**	
65/30	20-8274	Dep. mn
MATT–		
364	20-8228	Phys. Fluids, 8: 2115-17(1965)
MATT-Trans–		
14	20-8186	Dep. mn; CFSTI $2.00 cy, $0.50 mn; JCL $2.60 fs, $1.07 mf
MIT–	**(Misc.)**	
952-2	20-6694	Dep. mn; CFSTI $6.00 cy, $1.25 mn
3226-8	20-8003	Dep. mn; CFSTI $4.00 cy, $0.75 mn
MITS–		
53	20-7282	See NYO-10334
MLM–		
1281J	20-7608	Trans. Met. Soc. AIME, 233: 2011-13(1965)
1283	20-7569	Dep. mn; CFSTI $2.00 cy, $0.50 mn
MPI-PAE–	**(German)**	
P1.11/65	20-8182	Dep. mn
MPS-Int. LIN–	**(European Organization for Nuclear Research)**	
62-5	20-7675	Dep. mn
N–	**(Misc.)**	
65-25276	20-7536	CFSTI $4.00 cy, $0.75 mn
NAA-SR–		
9643	20-7570	Dep. mn; CFSTI $3.00 cy, $0.75 mn
9644	20-7571	Dep. mn; CFSTI $3.00 cy, $0.75 mn
11450	20-8392	Dep. mn; CFSTI $7.00 cy, $2.00 mn
NAA-SR-Memo–		
11239	20-8040	Dep. mn; CFSTI $4.00 cy, $1.00 mn
11418	20-8440	Dep. mn; CFSTI $1.00 cy, $0.50 mn
11423	20-8329	Dep. mn; CFSTI $1.00 cy, $0.50 mn
11435	20-8441	Dep. mn; CFSTI $1.00 cy, $0.50 mn
11495	20-7008	Dep. mn; CFSTI $2.00 cy, $0.50 mn
NAS-NS–	**(Misc.)**	
3002(Rev.)	20-7186	Dep. mn; CFSTI $2.00 cy, $0.50 mn
NASA-CR–	**(Misc.)**	
54189	20-7536	See N65-25276
54758	20-8442	
54775	20-7572	CFSTI $1.00 cy, $0.50 mn
54776	20-8443	CFSTI $1.00 cy, $0.50 mn
54780	20-7341	
NASA-TN–	**(Misc.)**	
D-3108	20-7367	CFSTI $1.00 cy, $0.50 mn
D-3119	20-8444	CFSTI $1.00 cy, $0.50 mn
D-3134	20-7719	CFSTI $1.00 cy, $0.50 mn
D-3144	20-7961	CFSTI $1.00 cy, $0.50 mn
D-3160	20-7720	CFSTI $2.00 cy, $0.50 mn
NASA-TT–	**(Non-AEC)**	
F-91	20-7748	CFSTI $5.00 cy, $1.00 mn
NBS-MISC.PUBL.–	**(Non-AEC)**	
260-9	20-8076	See NP-15663
NEIC-RR–	**(Polish)**	
18	20-7798	Dep.; $2.00 cy, $0.50 mn
NLCO–		
960	20-7009	Dep. mn; CFSTI $1.00 cy, $0.50 mn
963	20-7010	Dep. mn; CFSTI $1.00 cy, $0.50 mn
964	20-7011	Dep. mn; CFSTI $1.00 cy, $0.50 mn
969	20-7012	Dep. mn; CFSTI $2.00 cy, $0.50 mn
NP–	**(AEC File No. for Non-AEC Reports)**	
15164	20-7281	Dep. mn
15539	20-7127	Dep. mn
15590	20-8286	Dep. mn
15591	20-7747	Dep. mn
15607	20-6695	Dep. mn
15632	20-7302	
15641	20-7303	Dep. mn
15642	20-7307	Dep. mn
15643	20-7051	Bureau of Standards Free
15644	20-8462	
15648	20-8075	Dep. mn
15649	20-7013	Dep. mn
15658	20-7467	CFSTI $2.00 cy, $0.50 mn
15663	20-8076	GPO $0.15
15678	20-7312	
15688	20-7014	Dep. mn
15689	20-8330	
NUMEC–		
3524-8	20-7537	Dep. mn; CFSTI $2.00 cy, $0.50 mn
NYO–		
1163-59	20-7251	See VUF-1026
NYO–		

Report No.	Abstract No.	Availability
72-52(Suppl.1)	20-8077	Dep. mn; CFSTI $6.00 cy, $1.25 mn
841-3(Rev.)	20-8445	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1082-2	20-8078	Dep. mn; CFSTI $1.00 cy, $0.50 mn
2206-1	20-7128	Dep. mn; CFSTI $3.00 cy, $0.75 mn
2499-17	20-7129	Dep.mn; CFSTI $1.00 cy, $0.50 mn
2539-4	20-7313	Dep. mn; CFSTI $2.00 cy, $0.50 mn
2862-1	20-6908	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3228-5	20-8486	Dep. mn; CFSTI $4.00 cy, $0.75 mn
3399-03	20-7889	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3421-5	20-7368	Dep. mn; CFSTI $2.00 cy, $0.50 mn
10334	20-7282	Dep. mn; CFSTI $2.00 cy, $0.50 mn
ORINS–		
48	20-7538	Dep. mn; CFSTI $1.00 cy, $0.50 mn
ORNL–		
3694	20-8487	Dep. mn; CFSTI $3.00 cy, $0.50 mn
3849	20-7314	Dep. mn; CFSTI $6.00 cy, $1.25 mn
3853	20-6774	Dep. mn; CFSTI $6.00 cy, $1.25 mn
3855	20-8079	Dep. mn; CFSTI $4.00 cy, $0.75 mn
3872	20-8399	Dep. mn; CFSTI $5.00 cy, $1.00 mn
ORNL-NSIC–		
12	20-7317	ORNL Free
ORNL-P–	(Misc.)	
409	20-8234	Phys. Fluids, 8: 2281-7(1965)
940	20-7644	Nucl. Appl., 1: 478-83(1965)
1169	20-8482	Ann. Rev. Nucl. Sci., 15: 151-74(1965)
1200	20-7477	J. Appl. Phys., 36: 3693-6(1965)
1202	20-8483	Nucl. Struct. Eng., 2: 438-46(1965)
1417	20-8229	Phys. Fluids, 8: 2245-9(1965)
1456	20-7076	J. Amer. Chem. Soc., 87: 5377-9(1965)
1586	20-8119	Phys. Lett., 19: 358-9(1965)
1700	20-8080	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1701	20-8287	Dep. mn; CFSTI $2.00 cy, $0.75 mn
1703	20-6788	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1784	20-8400	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1786	20-8081	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1793	20-8082	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1830	20-6724	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1836	20-6725	Dep. mn; CFSTI $1.00 cy, $0.50 mn
ORNL-TM–		
1070	20-8463	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1241	20-8041	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1288	20-6702	Dep. mn; CFSTI $3.00 cy, $0.50 mn
1316	20-8488	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1317	20-6712	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1330	20-7573	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1335	20-7500	Dep. mn; CFSTI $3.00 cy, $0.75 mn
1340	20-7052	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1351	20-8464	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1356	20-7466	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1357	20-7015	Dep. mn; CFSTI $1.00 cy, $0.50 mn
OTR–	(Neo-AEC)	
131	20-7516	CFSTI Free
PAN–	(Polish)	(This series of reports was terminated in 1965. Subsequent reports are identified by the code INR)
PATENTS	(German)	
1,200,965	20-8374	
1,201,498	20-8370	
1,201,499	20-8338	
1,201,500	20-8339	
1,201,925	20-8178	
1,201,926	20-8340	
1,201,927	20-8341	
1,201,928	20-8375	
1,202,405	20-8342	
1,202,909	20-7459	
1,202,910	20-8437	
PATENTS	(Japanese)	
1964-16759	20-7546	
1964-17255	20-7120	
1964-18497	20-7668	
1964-18498	20-7656	
1964-18980	20-7183	
1964-19140	20-7684	
1964-19780	20-7685	
1964-20640	20-7212	
1964-20641	20-7213	
1964-20715	20-7187	
PATENTS	(U. S.)	($0.25 each, U. S. Patent Office)
3,219,541	20-7547	
3,222,125	20-7214	
3,222,144	20-8502	
3,222,289	20-7215	
3,223,598	20-8503	
3,224,944	20-7548	
PNE–		
238F	20-7318	Dep. mn; CFSTI $2.00 cy, $0.50 mn
480	20-7319	ORAU
PPAD–		
567D	20-7676	Dep. mn; CFSTI $2.00 cy, $0.50 mn
571F	20-7799	Dep. mn; CFSTI $4.00 cy, $0.75 mn
PUC–		
937-171A	20-8083	Dep. mn; CFSTI $5.00 cy, $1.00 mn
PWAC–	(Misc.)	
456(Del.)	20-8446	Dep. mn; CFSTI $1.00 cy, $0.50 mn
479	20-7574	Dep. mn; CFSTI $1.00 cy, $0.50 mn
481	20-7575	Dep. mn; CFSTI $1.00 cy, $0.50 mn
491	20-8447	Dep. mn; CFSTI $3.00 cy, $0.75 mn
499	20-7517	Dep. mn; CFSTI $3.00 cy, $0.75 mn
501	20-7518	Dep. mn; CFSTI $3.00 cy, $0.75 mn
R–	(Misc.)	
63CAP67	20-7230	Dep. mn
65SD29	20-8183	
2326	20-7189	See EURAEC-1339
2336	20-7190	See EURAEC-1396
RCN–	(Dutch)	
41	20-7519	Dep. mn
RFP–		
548	20-7576	Dep. mn; CFSTI $1.00 cy, $0.50 mn
598	20-7016	Dep. mn; CFSTI $2.00 cy, $0.50 mn
629	20-7053	Dep. mn; CFSTI $2.00 cy, $0.50 mn
RFX–	(Swedish)	
316	20-8465	Dep. mn
RISO–	(Danish)	
108	20-7320	Dep. mn
109	20-7321	Dep. mn
115	20-7721	Dep. mn
RL-SEP–		
550	20-7193	ORAU
RPI–	(Misc.)	
3176-1	20-7577	Dep. mn; CFSTI $2.00 cy, $0.50 mn
RT-FI–	(Italian)	
(65)10	20-7038	pp 121-32 of Fisica dello Stato Solido. Convegno Indetto dalla Societa Lombarda di Fisica, Pavia, 16–18 Luglio 1962. Rome, Consiglio Nazionale delle Ricerche, 1964.
(65)14	20-8349	Dep. mn
RT-FIMA–	(Italian)	
(65)5	20-8350	Dep. mn
RT-GEO–	(Italian)	
(65)4	20-7017	Dep. mn
RT-ING–	(Italian)	
(65)10	20-8365	Dep. mn
SC-DC–		
65-1790	20-7322	Dep. mn; CFSTI $1.00 cy, $0.50 mn
65-1826	20-8489	Dep. mn; CFSTI $1.00 cy, $0.50 mn
65-1898	20-7482	Dep. mn; CFSTI $1.00 cy, $0.80 mn

Report No.	Abstract No.	Availability
SC-DR-		
65-530	20-8466	Dep. mn; CFSTI $1.00 cy, $0.50 mn
SC-M-		
65-330	20-7283	Dep. mn; CFSTI $3.00 cy, $0.75 mn
SC-R-		
65-1004	20-8490	Dep. mn; CFSTI $2.00 cy, $0.50 mn
SC-RR-		
65-470	20-8491	Dep. mn; CFSTI $1.00 cy, $0.50 mn
65-502	20-7483	Dep. mn; CFSTI $5.00 cy, $1.00 mn
65-629	20-7054	Dep. mn; CFSTI $1.00 cy, $0.50 mn
SGAE-CH-	**(Austrian)**	
23/1965	20-7130	Dep.
SGAE-M-	**(Austrian)**	
3/1965	20-7578	Dep. mn
SGAE-SS-	**(Austrian)**	
1/1965	20-6703	Dep. mn
2/1965	20-7369	Dep.
SLAC-		
50	20-7677	Dep. mn; CFSTI $3.00 cy, $0.75 mn
51	20-7678	Dep. mn; CFSTI $2.00 cy, $0.50 mn
STI-DOC-	**(International Atomic Energy Agency)**	
10/48	20-6726	IAEA $3.50
11(Vol.3,No.2)	20-8492	IAEA Free
STI-PUB-	**(International Atomic Energy Agency)**	
21/15	20-6713	IAEA $3.00; S 63,-; 18/-stg; F.Fr.12,-; DM 10.50
SZS-	**(German)**	
7(1965)	20-8493	Dep. mn
TID-		
3515(Suppl.1)	20-6727	Dep. mn; CFSTI $6.00 cy, $1.50 mn
4100(Suppl.30)	20-7216	Dep.; DTI Extension Free
21910	20-7094	Nucl. Appl., 1: 490-2(1965)
22369	20-6728	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22375	20-6729	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22376	20-6730	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22390	20-7890	Dep. mn; CFSTI $1.00 cy, $0.50 mn
22395	20-7370	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22396	20-7800	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22411	20-7255	Dep. mn; CFSTI $3.00 cy, $0.75 mn
22426	20-7501	Dep. mn; CFSTI $1.00 cy, $0.50 mn
22427	20-8480	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22428	20-8481	Dep. mn; CFSTI $4.00 cy, $0.75 mn
22446	20-8042	Dep. mn; CFSTI $6.00 cy, $1.50 mn
22447	20-8043	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22449	20-8494	Dep. mn; CFSTI $4.00 cy, $0.75 mn
22452	20-7891	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22465	20-7231	Dep. mn; CFSTI $1.00 cy, $0.50 mn
22474	20-7018	Dep. mn; CFSTI $2.00 cy, $0.50 mn
22477	20-7223	Dep. mn; CFSTI $6.00 cy, $1.50 mn
22479	20-7633	Dep. mn; CFSTI $1.00 cy, $0.50 mn
TIM-	**(Misc.)**	
850	20-7579	Dep. mn; CFSTI $3.00 cy, $0.75 mn
945	20-7580	Dep. mn; CFSTI $2.00 cy, $0.50 mn
TT-	**(Canadian)**	
65-33616	20-6790	See JPRS-33039
65-33728	20-8497	See JPRS-33152
65-33746	20-6792	See JPRS-33170
UCLA-		
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